

TECHNICAL MANUAL

APPLICATION AND REMOVAL OF  
ORGANIC COATINGS,  
AEROSPACE AND NON-AEROSPACE  
EQUIPMENT

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(ATOS)

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## SAFETY SUMMARY

The following are general safety precautions and instructions that personnel must understand and apply during many phases of operation and maintenance to ensure personnel safety and health and the protection of Air Force property. Portions of this information may be repeated in certain chapters of this publication for emphasis.

### WARNING AND CAUTIONS STATEMENTS

WARNING and CAUTION statements have been strategically placed in the text to emphasize certain steps or procedures for the protection of personnel (WARNING) or equipment (CAUTION). A WARNING or CAUTION once provided will apply each time the related step is repeated, regardless of the number of times the WARNING or CAUTION is repeated throughout the text. Prior to starting any task, the WARNINGS or CAUTIONS included in the text for that task will be reviewed and understood.

### GIVE CLEANERS/CHEMICALS SPECIAL CARE

Keep cleaner/chemicals in approved safety containers and in minimum quantities. Some cleaners/chemicals may have an adverse effect on skin, eyes, and respiratory tract. Observe manufacturer's WARNING labels and current safety directives. Use cleaners/chemicals only in authorized areas. Discard soiled cloths into safety cans. Consult the local Bioenvironmental Engineer and/or Material Safety Data Sheets (MSDS) for specific precaution, protective equipment, and ventilation requirements.

### PERSONAL PROTECTIVE EQUIPMENT

Wear protective clothing/equipment (gloves, apron, eye protection, etc.) approved for materials, procedures and tools being used. Contact supervisor for guidance. If necessary, the Bioenvironmental Engineer or Base Safety Office should be contacted for guidance.

### USE SAFETY APPROVED EQUIPMENT

When cleaners and primers are being applied, approved explosion-proof lights, blowers, and other equipment shall be used. Ensure that firefighting equipment is readily available and in working order.



## SECTION I

### INTRODUCTION AND GENERAL DISCUSSION OF COATING MATERIALS AND TERMS

#### 1-1. SCOPE.

1-2. This technical manual outlines procedures and cites materials and equipment to be used on interior and exterior surfaces of aircraft, missiles and associated material or equipment in (a) preparing surfaces for painting and (b) correctly applying effective finishes. Some painting techniques are suggested and common difficulties discussed. Procedures for applying major Air Force complete coating systems are given. Some basic discussion of paint technology is included and a glossary of painting terms appended.

#### 1-3. PURPOSE.

1-4. The purpose of this technical order is to prescribe standardized procedures for the removal, application, and maintenance of exterior coating systems on Air Force systems and equipment. Its applicability is generally imposed by reference in system/item technical data. It also may be used where there is an absence of paint process requirements. System/item management activities have an obligation to require the use of this technical order to the maximum practical extent. It reflects the use of standard materials and procedures that meet Defense Standardization Program, AF Corrosion Prevention and Control Program, and Air Force policy (AFR 66-34) requirements. SM/IM offices should modify standard requirements or specify alternate requirements only as needed to support the peculiar requirements of their systems/equipment as stated in TO 00-5-1, paragraph 1-4.c. where there is a conflict between this general TO and the weapon system specific TO, the weapon system specific TO will take precedence. Such departures from standard should also be coordinated with all applicable OCRs (e.g., Corrosion Control, Ground Safety, Bioenvironmental Engineering, Environmental Management).

#### 1-5. INTRODUCTION.

##### NOTE

See TO 1-1-4 for Air Force policy on determining when individual aircraft are to be repainted or touched up.

1-6. The surfaces of aircraft, missiles and associated equipment are subjected to hostile environments both natural and man-made. Protecting surfaces from these environments is one of the most important elements in maintaining the structural

integrity and function of the entire mechanism. Inadequate control or prevention of metal corrosion or other forms of surface deterioration can shorten weapon/equipment life, can hinder mission accomplishment or endanger personnel or equipment and is costly. To add to their ability to resist detrimental environment, surfaces are coated in various ways and with a variety of materials. A general breakdown of these coatings would be into two main groups: inorganic and organic. The principal and most versatile means of protection, organic coating, or "paint", is the primary concern of this technical manual. In general, a suitable organic coating system, properly applied, offers greater protection against corrosion on metals than an inorganic finish (such as a metallic plating) alone and is more easily maintained. The scope of this technical manual requires consideration also of some inorganic materials, insofar as they are applied by painting personnel, or in direct preparation for painting.

#### 1-7. GENERAL DISCUSSION OF ORGANIC COATINGS.

##### NOTE

Precautionary measures shall be taken to prevent paint and paint removal waste from contaminating lakes and streams. Some of the chemicals utilized for painting and paint removal require treatment or other special control prior to disposal. Disposal of materials shall be accomplished under the direction of the Base Safety Office, Base Civil Engineer, Bioenvironmental Engineer, and Environmental Management in accordance with applicable directives and in a manner that will not result in violation of local, state, or federal pollution criteria. Detailed information for disposal is cited in AFM 85-14, AFM 85-11, AFM 91-11, AFR 91-9/AFLC Sup 1, AFR 19-1, and AFP 19-5.

1-8. To provide optimum protection from deterioration and corrosion, the proper coating systems (combination of pretreatment, primer, and topcoat) must be selected for a specific application. The selection of the proper coating system depends on the material to be coated, the environment to which the item will be subjected, and the service life requirement of the coating. No single coating or coating system can

perform adequately on all types of surfaces under all conditions to which Air Force equipment is subjected. For example, a phenolic paint conforming to Specification MIL-P-12507 is good for water immersion service or high humidity conditions, but may be inadequate for exposure to an industrial atmosphere. Many primers and topcoats can be used in various combinations; however, some primers are specifically formulated for a particular type topcoat. Lacquer primer, Specification MIL-P-7962, for example, is for use under acrylic nitrocellulose lacquers, Specifications MIL-L-19537 and MIL-L-19538. Use of this primer under enamels or polyurethane coatings will result in premature failure of the coating system.

**1-9. COATING SYSTEMS FOR METAL SURFACES.** Unless protected, surfaces of metals (with the exception of stainless steel, titanium and some of the more exotic metals) react with oxygen and various contaminants in the atmosphere, particularly in the presence of moisture, to form rust or other corrosion products. The most common method of preserving metals is by applying organic coatings.

**1-10. AIRCRAFT PROTECTIVE FINISH SYSTEMS.** Military Specification MIL-F-7179 covers the general requirements for protective finishes and coatings on aerospace weapon system structures and parts. (It does not necessarily govern coatings on aeronautical equipment such as propellers or power plants, nor those on accessories such as motors, generators, instruments, etc.) Two levels of coating protection are specified, depending on the environment to which the weapon system is to be subjected:

a. Type I coating protection is for use under conditions of severe deterioration. Seaplanes, aircraft that may operate from carriers or low free-board vessels, helicopters, amphibious aircraft, and missiles in ready status in marine environments are in this category.

b. Type II coating protection is for use under moderately severe deteriorating conditions.

**1-11. DEFINITIONS.** An organic coating or paint may be defined as a liquid or semi-liquid material which is applied to a surface by some mechanical means and which, when dried or cured, will provide an adherent film of certain desired characteristics. Organic coatings are variously classed as paints, enamels, varnishes and lacquers. As these classifications are not always practical, due to modern formulations, and because the coating materials dealt with in this technical manual are almost exclusively organic in chemical structure, the preferred term "organic coating" is used herein to designate finishing materials in general. For the purposes of this technical manual the term is extended to include some heavy elastomeric materials which are not truly "paints," and also certain chemical surface-treating materials which are not truly organic. These materials may or may not be applied by painting personnel, but are closely associated with painting operations. Also, the term "to paint" will continue to be used to signify the application of organic coatings by painters.

## SECTION II

## ORGANIC FINISH SYSTEM REMOVAL

## 2-1. INTRODUCTION.

2-2. The most important factor in removal of organic finish systems (coating/paints) is that complete removal is accomplished without damaging the surfaces on which the systems are applied. A variety of materials and either chemical or mechanical methods can remove finish systems. In choosing a material and a method, a compromise between maximum removal power and maximum protection for the equipment being stripped must be made. In addition, accessibility of areas to be stripped can dictate the types of materials and methods to be used. For these reasons, only those materials and methods described in this section subject to the restrictions noted in this section are authorized for general use in organic finish system removal from aerospace equipment. Adherence to organic finish system removal procedures and their sequence of performance in this section is mandatory. Other removal materials and methods can be authorized for limited and specific applications, but only when specifically approved and defined in system peculiar aircraft and/or equipment technical orders. The term "Depot Level" in this section refers to organizations and facilities which are involved in complete aircraft stripping operation on a routine, if not daily, basis. As of the publication of this TO, it does include the ALCs, all ATC bases, Bergstrom AFB regional strip facility, and contract stripping operations. It does not include field level maintenance facilities.

## NOTE

National Stock Numbers (NSN's), if assigned, for chemical removers, abrasives, and other materials and equipment authorized in this section can be found in Federal Supply Catalogs FSC 5345/50 and 8135 and FSC 7500, 7900, and 8000. Consult the current Master Cross Reference List (MCRL-1) to convert specification and part numbers to NSN's and the Management Data List (ML-C) for ordering and pricing information and shelf life codes.

## 2-3. GENERAL.

2-4. Organic finish systems shall be removed from Air Force aircraft and equipment only when the condition of deterioration of the system indicates the need for removal or when a requirement exists in a system peculiar Technical Order to remove the

system to perform a required inspection of the structure on which it is applied. This applies to stripping of components and small areas of aircraft and equipment as well as to the entire surface of aircraft or equipment. Removal of the entire exterior organic finish system from aircraft shall be accomplished in accordance with the criteria specified in TO 1-1-4 and the Aircraft System Program Manager's Service Life Paint Plan. Prior to any organic finish system removal, the following steps shall be taken in all cases:

a. Ensure that the facility to be used for finish system removal operations meets all the safety, fire precaution, health promotion, and environmental requirements in TO 42A-1-1 and that all personnel involved in finish system removal operations are provided with and are thoroughly familiar with the use of the personal protective equipment listed in TO 42A-1-1. Finish system removal operations shall not be performed by personnel who are not wearing proper protective equipment or in a facility which does not meet the requirements of TO 42A-1-1.

b. Ensure that the facility to be used for finish system removal operations provides the proper precautionary measures for disposal of finish system removal waste products as required by TO 42A-1-1 to prevent contamination of lakes, rivers, and streams. Many chemicals used in finish system removal operations and finish system residues require special treatment and control prior to disposal. Disposal shall be accomplished under the direction of the Base Safety Office, the Base Civil and Bioenvironmental Engineers, and the Environmental Management Office in a manner which will not violate local, state, and federal pollution regulations. Consult AFM 85-11, AFM 85-14, AFR 19-1, AFM 91-11, and AFR 91-9 with AFLC Sup. 1 for detailed information on disposal of finish system removal waste.

c. Determine the type of organic finish system to be removed so that the proper material and method for removal can be chosen from those listed in this section. Consult aircraft and/or equipment system peculiar technical orders and drawings, component drawings, aircraft historical records (AFTO Form 95), and/or the aircraft exterior finish identification marking on the aircraft (reference paragraph 3-4 and figure A-5 of TO 1-1-4) to help in this determination. If the finish system cannot be determined from these documents or they are not available, determine the finish system as follows:

(1) Rub a small area on the surface from which the finish system is to be removed vigorously with a cotton rag wet with O-A-51H, Technical Acetone. If the finish system is removed, it is a lacquer or alkyd enamel coating. If it is not removed, or very little is removed, it is a polyurethane or an epoxy coating.

(2) For polyurethane and epoxy coatings, scrape off the topcoat from a small area down to the primer coating with a knife blade or razor blade. If the primer is rubbery and a tan-gray color, it is a polysulfide primer. If the primer is hard and either a yellow or dark green (olive drab) color, it is either an epoxy or a polyurethane primer.

d. Study the removal operation to be performed and determine the most logical and efficient process for the job. If confined areas are involved, they shall be protected during a general overall removal operation, and shall be stripped using the special procedures in this section for these areas. If fiber glass, kevlar, or other composites are involved, they shall be stripped using the special procedures outlined later in this technical order. For extensive removal operations, such as removal of the entire exterior finish system on aircraft and large pieces of equipment, a detailed sequential step-by-step process specification conforming to all of the requirements in this section shall be prepared and followed. All personnel involved with finish system removal shall be trained in and thoroughly familiar with all requirements of this section.

e. Inspect surfaces from which the finish system is to be removed for grease, oil, and dirt. These materials act as a barrier between the finish system and the chemical or abrasive removers and contaminate recoverable air driven abrasives which causes excessive man-hours, longer flow time, and waste of materials during removal operations. Small amounts of these contaminants do not cause a problem; but if surfaces are exceptionally dirty, oily, or greasy, they shall be washed in accordance with TO 1-1-691 prior to removal operations. After washing, surfaces shall be either wiped dry, or sufficient time shall be allowed for them to air dry prior to removal operations.

f. Position the aircraft, equipment, or component from which the finish system is to be removed in a covered facility out of direct sunlight. If chemical removal methods are to be used, this facility shall be capable of maintaining the ambient air temperature within the range of 50°F to 100°F. In addition, the item from which the finish system is to be chemically removed shall be placed in the facility for a length of time sufficient to allow its surface temperature to reach 50°F to 90°F prior to application of the remover. While

chemical removal can be accomplished within the ambient air temperature range of 50°F to 100°F, severe difficulties will be encountered outside a temperature range of 60°F to 90°F. Below 60°F, chemical removal is very inefficient because the action of chemical removers is extremely slow; so the flow time, man-hours, and amount of remover required for chemical removal operations will be increased significantly. Above 90°F, the solvents in chemical removers evaporate so rapidly that removal efficiency is severely reduced and its drying on the surface leads to severe difficulties in cleaning finish system and remover residue from surfaces. This too will cause a significant increase in flow time, man-hours, and amount of remover required for chemical removal operations.

g. Protect all special areas, equipment, and materials by masking and/or other specified protective devices. For chemical removal operations, masking shall be accomplished with MIL-B-131, Class 1, barrier material and MIL-T-23397, Type II, (72-hour protection) aluminum backed, pressure sensitive tape. For extensive stripping operations such as depot level complete exterior finish system removal from aircraft and large pieces of equipment, use 3M Corp. P/N 425 tape (3M Corp. Address: Minnesota Mining and Manufacturing, Industrial Tape Div., 3M Center, St. Paul MN 55101). This is the only tape which will provide adequate protection for the extended time period involved with this type of operation. The engineering support activity for this technical order evaluates and approves tapes for this source control listing using the latest issue of MIL-T-23397. Chemical stripper CeeBee R256 is used as the testing agent for stripper resistance. Make sure that the plastic coated side of the MIL-B-131, Class 1, barrier material is toward the surface being protected or the plastic will be deteriorated by chemical removers.

h. For air driven abrasive removal operations unless otherwise noted, the same materials listed for chemical removal operations shall be used for masking of areas which will not be exposed to direct impingement of the abrasive media to prevent abrasive media intrusion. Impact Stripping Tapes, MIL-T-23397, Type III, are available in one to three inch wide by 30 feet long rolls. These tapes are available under NSNs 9390-01-359-7367/1 wide/9 rolls per box, 9390-01-359-7368/2 wide/6 rolls per box, and 9390-01-359-7369/3 wide/3 rolls per box. The tapes shall be used to mask areas which will be exposed to direct impingement of the bicarbonate of soda blast media. Hot glue may be used for masking for plastic media blasting (PMB) subject to the restrictions following.

(1) Materials:

(a) Hot glue gun - Polygun PC Applicator (3M 99302)

(b) Hot glue - reference item 3M 3748-TC

(c) Cotton rope

(d) Caulking cord - reference item More-Tite Putty

(e) Impact tape - 40 mils thick, 20 oz/in peel strength, 250% to 300% elongation, Shore A hardness 70-80. Reference items Anchor Continental BT-100 or 3M YR-300.

(2) Application. The hot glue is used to seal seams, covers and access panel gaps less than 3/16 inch. It is used to seal seams of impact tape for added protection. Fluid wicks are sealed in place using this material. The cotton rope is used as a fluid wick. It can also be used at saturated seams prior to sealing with hot glue. Caulking cord is used to fill seams and gaps in excess of 3/16 inch. Impact tape is used to protect areas not to be blasted. It is capable of withstanding a direct nozzle blast for a maximum of two seconds.

#### WARNING

Care must be taken to prevent hot glue from dripping on skin or eyes. Wear safety goggles.

#### CAUTION

Media intrusion into engines, gun assemblies, avionics, or actuators can severely damage the component. Extreme care must be exercised to mask every possible intrusion site.

(3) Procedures. Cover all antennas with impact tape. When masking off large areas, such as vents, use hard cardboard, sheet metal or equivalent, reinforced with impact tape over the side that will be exposed to PMB. When placing cover in position use impact tape to hold in place, then apply hot glue to seal edges. Seal all edges of impact tape with hot glue to eliminate possibility of tape peeling. In seams or protrusions where slow hydraulic leaks compromise masking integrity, install a wick (cotton rope) with a minimum four inch length and seal the wick in place with hot glue. Aircraft mold line drain holes should be plugged with rubber stoppers or equivalent and sealed with hot glue.

i. A detailed step-by-step checklist specifying the masking procedure shall be prepared for all

finish system removal operations. This checklist shall be used to insure that all required masking is accomplished prior to removal operations and that all masking is removed afterwards. The following areas shall be masked and/or otherwise protected for chemical and air driven abrasive finish system removal operations:

(1) Close all windows, doors, and hatches on aircraft or equipment; and mask gaps between the structure and these components. For air driven abrasive removal operations, these gaps may be stuffed full with sheets of MIL-B-131, Class 1, barrier material or heavy duty (0.004 inch thick) polyethylene or vinyl plastic film sheet to prevent abrasive media intrusion.

(2) Mask all transparent plastic and glass surfaces such as windows, canopies, and blisters; because they will be crazed, frosted, or lose transparency if exposed to chemical removers or if air driven abrasive media strikes them. For air driven abrasive removal operations, optional form fitting metal or wood shields may be fabricated for canopies and blisters in conjunction with 3M Corp. part No. 510, 3M Corp. YR-500, or Bron Tape, part No. 818 material cut to the exact size for windows.

#### CAUTION

Care should be taken when cutting and trimming of the barrier/tape to prevent damage to the transparent plastic and glass surfaces.

(3) Mask all radomes, antennas, fiber glass and/or composite structure, and rubber boots and/or all other rubber or elastomer surfaces to prevent chemical removers and air driven abrasive media from damaging these materials and/or components. (See paragraph 2-16.f. for composite paint stripping procedure).

(4) Mask all engine intake and exhaust openings and all openings or ports leading to interior cavities of structure to prevent entrapment of chemical removers and abrasive media. When masking aircraft pitot static ports and probes, the probe and port openings shall be covered with a disk of barrier material or paper prior to application of pressure sensitive tape to prevent tape adhesive from contaminating the interior and the openings of these probes and ports. The tape shall cover the barrier material or paper completely and overlap onto the aircraft surface approximately one half inch past the outside diameter of the pitot static port circular hole pattern. For scuff-sanding operations, locally-manufactured foam plugs/inserts may be used to protect aircraft inlet areas (e.g., scoops,

air intakes, engine intakes, etc.) from scuff-sanding residue as a replacement for masking and barrier paper. It is recommended that MIL-P-26514, cushion material, be used in the making of foam plugs/inserts. One side of the plug should be covered in replaceable plastic or barrier material for easy cleanup.

(5) Mask all seams of removable personnel, equipment, and inspection access panels and doors for chemical removal operations to prevent seepage of the remover into joints.

(6) Mask all edges, repairs, and loose fasteners on honeycomb and metal to metal adhesively bonded panels and doors for chemical removal operations to prevent chemical removers from damaging adhesives and disbonding adhesively bonded structure.

(7) If aircraft has fabric covered control surfaces (rudders, elevators, ailerons, etc.), either completely mask them or remove them from the aircraft prior to any paint removal operations in the area of these components as the fabric can be damaged by chemical removers and air driven abrasive media.

(8) Sometimes replacements for very detailed or highly specialized decalcomania (decals) are very difficult to obtain. Mask these types of decals using barrier paper over the decal if directed to save them.

(9) Mask all other areas specified in and as directed by system peculiar aircraft or equipment technical orders such as aircraft -23 corrosion technical orders.

#### NOTE

For extensive chemical removal operations such as entire aircraft exterior finish system removal, it may be more efficient and practical to strip those areas of the finish system which will be covered by masking tape by the hand residual finish system removal procedures in this section prior to masking for the overall removal operation. This is authorized as long as extreme care is taken to prevent damage to areas which require protection by masking, all remover and finish system residue is thoroughly removed from the stripped areas and areas around them, and surfaces on which masking tape will be applied are solvent wiped with a cotton rag wetted with TT-I-735 isopropyl alcohol followed by wiping dry with a clean cotton rag before the alcohol evaporates.

#### 2-5. ORGANIC FINISH SYSTEM REMOVAL.

2-6. There are two methods for removal of organic finishing systems -chemical and mechanical. Each method has its own set of procedures, precautions, restrictions, and limitations; and therefore, each will be explained separately. Procedures discussed in this paragraph are for general overall removal. If confined areas or non-metallic structure are involved in the removal operation, specific procedures for these areas in other paragraphs of this section shall be used.

#### 2-7. CHEMICAL REMOVAL OF ORGANIC FINISH SYSTEMS.

2-8. Chemical removal procedures and their sequence of performance are essentially the same for all types of organic finish systems, all types of chemical removers, and either limited or extensive removal operations. However, the type of chemical remover used depends on the type of organic finish system to be removed.

## 2-9. SELECTION OF A CHEMICAL REMOVER.

2-10. The type of chemical remover used to remove an organic finish system varies according to the type of system to be removed: zinc chromate primer, lacquer or alkyd enamel topcoats over zinc chromate primer, epoxy and polyurethane primers, epoxy and polyurethane topcoats over epoxy or polyurethane primers, or polyurethane topcoat over polysulfide primer. The approved types of chemical removers which shall be used to remove each of these organic finish systems are identified below along with precautions to be used for each type:

### NOTE

All chemical removers have a shelf life of six months from the date of manufacture unless otherwise specified, if they are stored and maintained under the proper conditions, and they should be ordered in quantities and by intervals which allow all chemical removers on hand to be used prior to the shelf life expiration date. Chemical removers shall be stored in a protected area out of direct sunlight capable of maintaining a temperature of 40°F to 100°F to prevent them from freezing or being exposed to excessively high temperatures. Chemical removers rapidly deteriorate at temperatures exceeding 100° F, and many of them become corrosive. Exposure to freezing temperatures causes them to separate in such a way that the components cannot be remixed to a homogeneous solution. In either case, they become totally ineffective. While not necessarily unsatisfactory after six months of age, chemical removers do deteriorate and lose removal efficiency on aging beyond six months; and some start to become corrosive. A definite age control program shall be established on chemical removers by the using activity, and any material which is questionable due to improper storage and/or exceeding its shelf life shall be laboratory tested and updated in accordance with TO 00-20K-1 prior to use. Particular

attention shall be given to the corrosivity of chemical removers during testing.

a. Remover for Zinc Chromate Primer and Lacquer or Alkyd Enamel Topcoats Over Zinc Chromate Primer on USAF Aircraft, Missile, or Equipment Metal Surfaces.

(1) Remover, Paint and Lacquer, Solvent Type MIL-R-25134 is the approved chemical remover for zinc chromate primer, TT-P-1757 (MIL-P-8585); lacquer topcoats; TT-L-20, TT-L-32, TT-L-50, MIL-L-19537, MIL-L-19538, MIL-L-81352, etc.; and alkyd enamel topcoats, TT-E-489, TT-E-527, TT-E-529, MIL-E-46136, etc. This remover is a heavy bodied or very viscous liquid, usually yellow in color, consisting primarily of methylene chloride (dichloromethane), a small amount of ammonia, and small amounts of thickening and wetting agents designed to remove multiple coats of lacquers and alkyd enamels by solvent action. This remover shall be applied full strength, with no dilution, to the surface from which the finish system is to be removed in a smooth, even coat by either a brush or a non-atomizing type sprayer. This remover normally causes enamels to wrinkle and lacquers to soften (lacquers don't wrinkle) within 5 to 15 minutes after application, but a longer dwell time is often required if numerous coats are present on the surface and environmental conditions are not ideal. Products conforming to MIL-R-25134 have been tested and proven not to cause hydrogen embrittlement of high strength steels or corrosion beyond established limits of the various metals used on USAF aircraft, missiles, and equipment. These products are identified in a Qualified Products List (QPL) for MIL-R-25134, and only those products listed on the most current revision of this QPL shall be purchased for and used on USAF aircraft, missiles, or equipment. Questions regarding products qualified to MIL-R-25134 shall be referred to WR-ALC/ TIEA.

(2) Products listed in this section for removal of epoxy and polyurethane primers and epoxy and polyurethane topcoats over epoxy or polyurethane primers can and may be used to remove zinc chromate primer and lacquer or alkyd enamel topcoats over zinc chromate primer in lieu of MIL-R-25134 remover as long as precautions for these materials given in this section are followed. It should be noted, however, that these removers are more expensive than MIL-R-25134 removers and require much more stringent measures for waste disposal and pollution control.

b. Remover for Epoxy and Polyurethane Primers and Epoxy and Polyurethane Topcoats Over Epoxy or Polyurethane Primers on USAF Aircraft, Missile, or Equipment Metal Surfaces. At

this time, there are no USAF approved military or federal specification removers for removal of these finish systems from USAF aircraft, missiles, and equipment. Several proprietary removers of two different types, phenolic and non-phenolic/non-cresylic, have been tested and proven not to cause hydrogen embrittlement of high strength steels or corrosion beyond established limits of the various metals used on USAF aircraft, missiles or equipment. Testing of these removers included evaluation of their ability to remove military specification epoxy and polyurethane finish systems, but evaluation was not all inclusive to consider all possible variables. Each of these removers is chemically unique and not necessarily interchangeable with others for a particular task. Production variables affecting the choice of removers include the brand and age of the finish system, type of surface to which it is applied (metal type, large/small area, horizontal/ vertical surface), local climate, capabilities of local industrial waste treatment facilities, EPA and local environmental restrictions on remover and paint residue disposal, and local medical and bioenvironmental authority concerns for worker contact with the higher acid type products. It is a known fact that the phenolic type removers are much more efficient than the non-phenolic/non-cresylic type removers for removal of these finish systems, but they present waste disposal problems and require treatment facilities capable of handling them. Each activity is authorized and encouraged to service test the listed removers to evaluate effectiveness for their own particular situation and to select a preferred remover and one or two alternates, if possible, to promote competition. Each Air Logistics Center (ALC), either alone or in concert with other ALC's shall prepare a Purchase Description (PD) with a Qualified Products List (QPL) to establish testing and qualification procedures for removers authorized for use in their facility (ies) from among those listed in this paragraph. Testing shall include removal efficiency tests from test panels with one coat of epoxy or polyurethane primer and two coats of epoxy or polyurethane topcoat air dried for seven days at room temperature and then baked for 4 days in an oven at 210°F + 10°F. Criteria for passage of the test shall be complete removal of the finish system to bare metal in 15 minutes maximum for phenolic removers and one hour for non-phenolic/non-cresylic removers. It should be understood that removal time for a finish system which has been in service for several years is somewhat longer than for removal of the same finish system from test panels prepared as noted above and is also dependent on the number of overcoats present on the surface and environmental conditions in the removal facility. These removers are heavy bodied or very viscous liquids, usually yellow or brown in color, designed specifically to remove epoxy and

polyurethane finish systems by solvent action. These removers shall be applied full strength, with no dilution, to the surface from which the finish system is to be removed in a smooth even coat by either a brush or a non-atomizing type sprayer. The removers authorized to remove epoxy and polyurethane finish systems from USAF aircraft, missiles, and equipment are identified below by Part Number (P/N) and source of supply.

(1) Phenolic Type Removers:

(a) P/N B&B 1567 - B&B Chemical Co., Inc., 875 W. 20th St.; Hialeah, FL 33010.

(b) P/N Cee Bee R-256 - Cee Bee Div., McGean-Roch, Inc., 9520 E. Cee Bee Dr.; Downey, CA 90241.

(c) P/N's 739A & 768A - Chemical Specialties Div. (Western Operations), Pennwalt Corp.; 2700 S. Eastern Ave.; Los Angeles, CA 90040.

(d) P/N PR-3500 - Eldorado Chemical Co., Inc.; P. O. Box 34837; San Antonio, TX 78265-4837.

(e) P/N Stripper 506 - EZE Products, Inc.; P. O. Box 2464; Greenville, SC 29602.

(f) P/N's 5292 & 5351 - Turco Products Div., Purex Corp.; 24600 S. Main St.; Carson, CA 90749.

(g) P/N 3812 - Omega Chemical Products Group; 6935 W. 62nd St.; Chicago, IL 60638.

(2) Non-Phenolic/Non-Cresylic Type Removers:

(a) P/N B&B 4411 - B&B Chemical Co., Inc., 875 W. 20th St.; Hialeah, FL 33010.

(b) P/N PR-3400 - Eldorado Chemical Co., Inc.; P. O. Box 34837; San Antonio, TX 78265-4837.

(c) P/N Inland AP-599-Inland Chemical Corp.; 1810 Magnavox Way; Fort Wayne, IN 46804.

(d) P/N Intex 857 - Intex Products, Inc.; P. O. Box 6648; Greenville, SC 29606.

(e) Deleted.

(f) P/N Cee Bee A-292 - Cee Bee Div., McGean-Roch, Inc.; 9520 E. Cee Bee Dr.; Downey, CA 90241.

c. Remover for Polysulfide Primer with a Polyurethane Topcoat on USAF Aircraft, Missile, and Equipment Metal Surfaces. At this time, there are no USAF approved military or federal specification removers for removal of this finish system. A few proprietary removers have been tested and proven



not to cause hydrogen embrittlement of high strength steels or corrosion beyond established limits of the various metals used on USAF aircraft, missiles, and equipment. Only those products listed in this paragraph shall be purchased for and used on USAF aircraft, missiles, and equipment. Testing of these removers included evaluation of their ability to remove military specification polyurethane topcoats and their underlying polysulfide primer. While these removers will remove military specification polyurethane topcoats, it was found that it is much more efficient to remove polyurethane topcoats with one of the removers listed for epoxy and polyurethane finish systems first and then to remove the polysulfide primer with one of the removers listed in this paragraph. This method is highly recommended to avoid excessive use of materials, man-hours, and flow time in removal of this finish system. Each Air Logistics Center (ALC), either alone or in concert with other ALC's shall prepare a Purchase Description (PD) with a Qualified Products List (QPL) to establish testing and qualification procedures for removers authorized for use in their facility (ies) from among those listed in this paragraph. Testing shall include removal efficiency tests from test panels with one coat of polysulfide primer (PR-1432GP) and two coats of polyurethane topcoat air dried for seven days at room temperature and then bake for 4 days in an oven at  $210^{\circ}\text{F} + 10^{\circ}\text{F}$ . Criteria for passage of the test shall be complete removal of the entire finish system to bare metal in one hour maximum using just the removers listed in this paragraph and complete removal of the polysulfide primer to bare metal in 30 minutes maximum using the removers listed in this paragraph on the primer after the topcoat is removed using one of the removers listed for epoxy and polyurethane finish systems. It should be understood that removal time for a finish system which has been in service for several years is somewhat longer than for removal of the same finish system from test panels prepared as noted above and is also dependent on the number of overcoats present on the surface and environmental conditions in the removal facility. These removers are heavy bodied or very viscous liquids designed specifically to remove polyurethane primer with a polyurethane topcoat by solvent action - preferably after the polyurethane topcoat has been removed with one of the removers listed for epoxy and polyurethane finish systems. These removers shall be applied full strength, with no dilution, to the surface from which the finish system is to be removed by either a brush or a non-atomizing type sprayer. The removers authorized to remove polysulfide primer with a polyurethane topcoat from USAF aircraft, missiles, and equipment are identified below by Part Number (P/N) and source of supply.

**CAUTION**

The maximum shelf life of P/N B&B 5151A Remover is three months. This remover shall not be used if it is older than three months from the date of manufacture.

(1) P/N B&B 5151A - B&B Chemical Co., Inc.; 875 W. 20th St.; Hialeah, FL 33010.

(2) P/N Cee Bee A-458 - Cee Bee Div., McGean-Roch, Inc.; 9520 E. Cee Bee Dr.; Downey, CA 90241.

**2-10A. REMOVERS FOR ENVIRONMENTAL COMPLIANCE.** In addition to those removers addressed in the preceding paragraphs, commercially available coating removers based on benzyl alcohol and alternate alkaline materials have been screened and are approved for use on weapon systems.

a. These products offer the advantage of reducing hazardous waste generation in the chemical stripping process and they contain ingredients which are not currently listed as hazardous materials for occupational health or environmental contamination. However, skin and eye protection is still required. The bioenvironmental engineering authority shall have to be consulted for minimum personal protection requirements. Coordination shall also have to be effected with the local environmental coordinator to establish the proper handling and disposal procedures for the stripper and the process waste for the locale in which it is used. These products have flash points that range from  $150^{\circ}\text{F}$  to over  $200^{\circ}\text{F}$ . Since the flash points are above  $100^{\circ}\text{F}$  they are not classified as flammable materials, however, they are classified as combustible materials. Their use should be coordinated with the local fire department authority.

b. Products which have passed the corrosion and hydrogen embrittlement performance requirements are listed below. The products do not afford the same production rates as are customary with the traditional methylene chloride and phenol containing removers. The detail composition, the time-based removal efficiency and the effectiveness on certain types of coatings varies for each product. The products are chemically unique and are not necessarily interchangeable for a particular task. The products are generally effective for topcoat removal but give differing degrees of effectiveness and efficiency with primers.

c. The following removers are authorized to remove organic finishes from USAF aircraft, missiles and equipment:

(1) The removers listed below are for epoxy/polyurethane primer and polyurethane topcoats.

- (a) P/N CeeBee E-1092A-  
CeeBee Div, McGean-Rohco Inc.  
9520 E CeeBee Dr,  
Downey CA 90241.
- (b) P/N 3131 - Eldorado  
Chemical Company Inc.  
P.O. Box 34837,  
San Antonio TX 78265.
- (c) P/N 541-  
EZE Products Inc.  
P.O. Box 5744,  
Greenville SC 29606.
- (d) P/N 6813 - Turco  
Products Inc.  
7300 Bolsa Avenue,  
Westminister, CA 92684.
- (e) B&B 9400 - B&B  
Tritech, Inc.  
P.O. Box 660776,  
Miami FL. 33266-0776.
- (f) P/N CeeBee Div - E2000-  
CeeBee Div, McGean-Rohco Inc.  
9520 E CeeBee Dr,  
Downey, CA 90241
- (g) P/N CeeBee Div - E2002A  
CeeBee Div, McGean-Rohco Inc.  
9520 E. CeeBee Dr,  
Downey, CA 90241

(2) The removers listed below are for polysulfide primers.

- (a) P/N CeeBee E-1058 -  
Cee Bee Div, McGean-Rohco Inc.  
9520 E Cee Bee Dr,  
Downey CA 90241.
- (b) P/N SR-125A - Eldorado  
Chemical Company Inc,  
P.O. Box 34837,  
San Antonio TX 78265.
- (c) P/N 5151B - B&B  
Tritech, Inc.  
P.O. Box 660776,  
Miami FL 33266-0776
- (d) P/N 542-  
EZE Products Inc.  
P. O. Box 5744  
Greenville SC 29606
- (e) P/N SR 145 - Eldorado  
Chemical Company Inc.

P.O. Box 34837  
San Antonio TX 78265

- (f) P/N CeeBee - E-1058A  
CeeBee Div, McGean-Rohco Inc.  
9520 E. CeeBee Dr.  
Downey, CA 90241

#### NOTE

The polysulfide primer removers are available in thin viscosity for use in tank operations.

2-11. GENERAL OVERALL CHEMICAL REMOVAL PROCEDURES. Chemical removal of organic finish systems shall be performed in accordance with the following sequential steps:

#### WARNING

Chemical removers are toxic to skin, eyes, and respiratory tract. Skin and eye protection required. Contact Bio-environmental Engineering for determination of need for respiratory protection and selection of proper respiratory protection when it is required.

a. Ensure that all facility safety, health, and disposal requirements and all personnel safety and health requirements in paragraphs 2-4.a. and b. are met.

b. Determine the type of organic finish to be removed in accordance with paragraph 2-4.c. Select and obtain the proper chemical remover for the finish system involved in accordance with paragraph 2-10.

c. Ensure that the removal operation has been properly planned and that all personnel understand the operation as required by paragraph 2-4.d.

d. Ensure that the aircraft, equipment or component has been properly cleaned, dried, and masked in accordance with paragraphs 2-4.e. and g.

e. Ensure that the aircraft, equipment, or component has a surface temperature within the specified range and is located within a covered facility having an ambient air temperature within the specified range as defined in paragraph 2-4.f.

f. Mix the chemical remover well with a mechanical mixer or a wooden paddle immediately before use as chemical removers tend to separate on standing. Do not mix by rolling a drum of

chemical remover as this will not mix the material adequately.

g. Apply a light to medium thick, uniform coat of chemical remover to the area of the aircraft, equipment, or component from which the finish system is to be removed with a long handled specification MIL-B-23958 non-metallic brush (type and style are optional) or a non-atomizing type sprayer wand fitted to a barrel pump. Never

use an atomized spray to apply chemical removers. Do not apply thick coats of chemical removers as this actually slows down the removal rate, creates a more extensive waste disposal operation, and waste expensive chemical removers. Efficient removal requires maintaining a wet film of remover on the surface. Active ingredients in chemical removers

are highly volatile and evaporate rapidly; so after about one hour dwell time, removers begin to dry out and no longer react on the finish system as most of the active ingredients have evaporated. For an effective removal operation chemical removers must be applied progressively and in a planned logical sequence. Apply strippers to areas no larger than can be effectively worked by the personnel on hand to perform the operation. Strippers should not be applied to a second area prior to completion of the removal operation in an area being worked. This is particularly important for extensive removal operations such as removal of the entire exterior finish system from an aircraft. Preferably, application of chemical removers should begin at the highest point of a vertical or sloping surface to prevent removers from running down onto surfaces from which the finish system has already been removed; but this is an optional decision to be made by local management.

h. Allow the chemical remover to dwell on the surface undisturbed for 15 minutes, and then agitate several spots on the surface with MIL-A-9962, Type I, Grade B abrasive mat, a MIL-B-23958, Type I or III brush, or a "No. 241 Prolene" brush to determine if the finish system has been loosened down to bare metal. If the finish system has loosened down to bare metal at this point, proceed to next step; if not, repeat the 15-minute dwell and spot agitation procedure until loosening of the finish system down to bare metal is indicated or a maximum of one hour dwell time has elapsed and then proceed to the next step: The maximum does not apply to the environmental strippers in paragraph 2-10A. Dwell times for these removers will be appreciably longer.

i. When the finish system has loosened to bare metal or exceeds a reasonable dwell time, thoroughly agitate the entire area on which the chemical remover has been applied with a "No. 241 Prolene" brush preferably or a MIL-B-23958, Type I or III brush while exerting as much pressure with the brush as possible.

#### CAUTION

- Never allow a chemical remover to dry on the surface to which it is applied as it is extremely difficult to remove after it dries.
- Never water rinse surfaces between chemical remover applications as this

interferes with the removal action and tends to set up the remaining finish system on the surface making it very difficult to remove. Schedule removal operations so that once started on an area, they proceed without interruption through the entire sequence to complete removal to bare metal. If the operation must be interrupted due to some scheduling problem or the work day ending, scrape off all chemical remover with a rubber bladed squeegee and rinse the area with water as directed below prior to stopping work. When a chemical removal operation is interrupted in this fashion, extreme difficulty will be encountered in removal of the remaining finish system from the area where work was stopped requiring increased amounts and applications of chemical removers, increased man-hours for the operation, and significant flow time delays. If the area is exposed to direct sunlight during the interruption, even more difficulty will be experienced in removal of the remaining finish system. Never restart chemical remover application until the area is completely dry.

#### NOTE

A "No. 241 Prolene" brush is available under NSN 7920-01-089-9077 by base level local purchase from Intex Products, Inc., P. O. box 5548; Greenville, SC 29606. A MIL-B-23958, Type I, brush is available through GSA under NSN 7920-00-051-4383 (rectangular, nylon bristles) or NSN 7920-00-054-7768 (round, nylon bristles). A MIL-B-23958, Type III brush is available through GSA under NSN 7920-00-051-4384 (round, nylon, and ampico bristles).

j. Immediately after agitation, scrape all loosened finish system residue and chemical remover from the surface with a rubber bladed squeegee; and immediately reapply fresh chemical remover per step 2-11g. on spots where the finish system has not been removed down to bare metal in the area being worked, and repeat steps 2-11h. and i.

**CAUTION**

Only those aluminum wools and brushes specified shall be used to agitate metallic surfaces during finish system removal operations. Other types of metallic wools and brushes, such as steel, copper, brass, beryllium copper, etc., shall not be used as they will either embed in or smear on the metallic surface and cause severe galvanic corrosion problems.

**NOTE**

If a polysulfide primer/polyurethane topcoat finish system is being removed and the first application of chemical remover takes off the topcoat but not the primer, the second and subsequent applications shall be with one of the chemical removers specified in this manual for removing polysulfide primer.

k. Repeat the removal sequence, steps 2-11g. through j., in the area being worked as necessary to remove the finish system down to bare metal up to a maximum of three times. For the second and all subsequent applications of chemical remover agitate the surface with MIL-A-9962, Type I, Grade B or C nylon abrasive mat; FF-W-1825, Type IV, Class 1, Form A or A-A-1044, Type II, Class 1, Form A, aluminum wool; and/or H-B-178/1-5 (P/N H-B-178/1-5) aluminum wire brushes to assist in the removal operation.

**NOTE**

- MIL-A-9962, Type I, nylon abrasive mat is available under NSN 5350-00-967-5093 for 10 sheets of Grade B (fine) material and NSN 5350-00-697-5092 for 10 sheets of Grade C (medium) material.
- FF-W-1825, Type IV, Class 1, Form A or A-A-1044, Type II, Class 1, Form A, aluminum wool is available under NSN 5350-00-286-4851 or 5350-00-312-6129 for 25 one pound rolls.
- H-B-178/1-5 (P/N H-B-178/1-5) aluminum wire brushes are available under NSN 7920-01-067-6192 for one brush.

l. As soon as the finish system has been removed down to bare metal or the final attempt at overall chemical removal has been completed and the chemical remover and finish system residue has been scraped from the surface with a rubber bladed

squeegee in the area being worked, flush the area thoroughly with hot, high pressure water at a temperature of 100°F to 120°F and a pressure of 150-250 psi. Start at the lowest point and work upward using care to keep the water off adjacent areas from which the finish system will be removed.

**NOTE**

- If hot, high pressure water is not available, fresh tap water at hydrant pressure may be used for the flush operation. However, it should be well understood that this will make the final cleaning/washing step much more difficult and require additional man-hours and flow time to accomplish, because cold water tends to gel waxy compounds used in chemical removers and deposit them on the surface.
- When removing zinc chromate primer having no topcoat, flush the area with water as soon as possible after it has been loosened by the chemical remover and scraped from the surface as it tends to readily redeposit on the surface if the surface becomes dry thus requiring another application of chemical remover.
- m. After the area being worked has been thoroughly flushed with water, remove tape used for masking within the area by hand; or, as an alternate, remove it with the hot, high pressure water at the same time the area is being flushed.
- n. Remove any residual finish system from very stubborn spots and spots covered with tape during the general removal operation using care to prevent chemical removal materials from entering into and becoming entrapped in confined areas and/or causing damage to structure, components or materials. Apply the same chemical removers used for the general removal operation, specification MIL-D-6998 dichloromethane, specification MIL-T-81722, Type I or II thinner, specification TT-E-751 ethyl acetate, and/or specification TT-T-266 lacquer thinner by dabbing them on the spots with a small non-metallic bristle brush. Agitate the spots with the same materials listed for agitation during the general removal operation and/or non metallic/plastic scrapers while the chemical remover or solvent is on the surface. Wipe the loosened finish system and chemical remover off the surface with a cotton rag; and if necessary, abrade the remaining finish system off the surface with either a random orbital tool or pneumatic drill motor (10,000 rpm max) fitted with a fine or medium grade "Scotch-Brite" aluminum oxide coated nylon

mesh abrasive flap wheel or a roloc or hook and loop mounted surface conditioning disc (3M Corp; Building Service and Cleaning Products Div.; St. Paul, MN 55144). Wipe the spots from which residual finish system was removed with a cotton rag wetted with fresh water, and then dry them with a clean cotton rag.

o. If the area just completed is the final area from which the finish system is to be removed, proceed directly to the next step. If other areas are to be worked, repeat steps 2-11g. through n. on the next area. Application of chemical remover on a new area may begin as soon as the flushing operation is completed and while the residual finish system removal operation is in progress on an area being worked as long as enough personnel are on hand to work both areas effectively.

p. Immediately after finishing the chemical removal operation on the last area from which the finish system is being removed, thoroughly wash all areas of the aircraft, equipment or component from which the finish system has been removed and those adjacent areas which may have been exposed to or contaminated with chemical remover in accordance with TO 1-1-691, the aircraft -23 technical order, and/or the equipment system peculiar technical order. Inspect all areas where chemical remover may have become entrapped, and clean these areas as required. The aircraft, equipment or component shall not be removed from the removal facility until this washing operation is completed.

2-12. CHEMICAL REMOVAL PROCEDURES FOR CONFINED LOCATIONS. When use of the chemical removers, listed in paragraph 2-10, of this manual is impractical because of assembly complexities and/or rinsing difficulties, remove the finish system from metal surfaces using specification MIL-T-81722, Type I or II thinner, specification TT-E-751 ethyl acetate, or specification TT-T-266 lacquer thinner in accordance with the following procedures.

### WARNING

- Specifications MIL-T-81722, Type I or II thinner, TT-E-751 ethyl acetate, and TT-T-266 lacquer thinner are flammable. Avoid all sources of ignition.
- Chemical removers are toxic to skin, eyes, and respiratory tract. Skin and eye protection required. Contact Bio-environmental Engineering for determination of need for respiratory protection and selection of proper

respiratory protection when it is required.

- Use extreme caution when using specifications MIL-T-81772, Type I or II thinner, TT-E-751 ethyl acetate or TT-T-266 lacquer thinner in areas where liquid oxygen storage and transfer equipment are located. Never use these materials on valves, flanges or other components where they may come in direct contact with liquid oxygen or pure oxygen vapor.

### CAUTION

Do not allow these materials to spread to adjacent areas not being worked or to splash, overspray or spill onto adjacent rubber, synthetic rubber, plastic, composite materials or components as damage to the finish system on adjacent areas and these materials and components will result.

a. Apply one of the solvents selected from the list above to the area from which the finish system is to be removed with a small non-metallic bristle brush or a clean cotton rag.

b. Allow the solvent to dwell on the surface until all the finish system to be removed has softened and/or lifted from the surface. It may be necessary to keep a rag saturated with solvent on the surface in order to keep the surface wet for the time required to lift the finish system.

c. Agitate the surface at frequent intervals using the same abrasive materials and scrapers listed for agitation and residual finish system removal in paragraphs 2-11.k. and 2-11.n., and wipe loosened finish system residue from the surface with clean cotton rags wetted with the same solvent being used for removal.

d. Repeat steps 2-12.a. through c. as necessary until all finish system and residue have been removed from the metal surface including recesses around rivets, bolts, etc.

e. Wipe the area clean with a clean cotton rag wetted with fresh tap water, and then wipe the area dry with a clean cotton rag.

2-13. ORGANIC FINISH SYSTEM REMOVAL FROM NON-METALLICS. For the purpose of this manual, non-metallic are defined as fabric covered surfaces, fiber glass and aramid fiber ("Kevlar")/epoxy laminated composite structures and components, and graphite or boron/epoxy laminated composite structures and components, since

these are usually the only non-metallics which will require finish system removal. The finish system shall be removed from non-metallics as follows:

**WARNING**

Specification TT-T-266 lacquer thinner and Specification MIL-T-6096 dope thinner are flammable and toxic to the skin, eyes, and respiratory tract. Avoid all sources of ignition. Skin and eye protection required. Good general ventilation is normally adequate.

**CAUTION**

- Chemical removers used for finish system removal from metal surfaces shall not be used on fabric covered surfaces because they tend to leave deposits in the fabric which cause early failure of the finish system reapplied on the fabric surface.
- Sharp edged and sharp cornered tools shall not be used as scrapers for removal of the finish system from fabric covered surfaces as they can easily puncture or tear the fabric. Scrapers shall not be pushed across the surface, but shall be held with the blade angled away from the body and pulled across the surface toward the body to prevent gouging of the fabric.

a. Fabric Covered Surfaces. Consult TO 1-1A-11 for additional procedures and precautions when working with fabric covered surfaces, and then remove the finish system as follows:

(1) Apply Specification TT-T-266 lacquer thinner or Specification MIL-T-6096 dope thinner to the dope and/or lacquer finished fabric surface with a soft non-metallic bristle brush, a soft cotton fiber mop, or a cotton rag.

(2) Allow the thinner to dwell on the surface just long enough to soften the dope and/or lacquer film.

(3) As soon as it has softened, scrape the dope and/or lacquer film from the surface with a dull edge metal putty knife or plastic scraper having rounded corners held with the blade angled away from the body by pulling it across the surface toward the body.

(4) Repeat steps (1) through (3) as necessary until the finish system is entirely removed.

(5) After the finish system has been removed, wipe the fabric surface with a cotton rag wetted with the thinner used for the removal process to clean off any remaining residue, and then let the fabric surface air dry before proceeding with other maintenance actions.

**CAUTION**

- Chemical removers used for finish system removal from metal surfaces shall not be used on composite surfaces because they attack the epoxy or polyester resin matrix of composites and, therefore, can severely damage these materials.
- Plastic Media Blasting (PMB) may be used on composite materials providing that it is performed in accordance with procedures outlined in Section 2-16 of this technical order and also providing that its use has been approved by the specific aircraft's Systems Program Manager (SPM). In all cases, operators using PMB must use the method to remove only the paint from composite surfaces. The underlying primer coat must be used as a "flag" to signal to the PMB operator that the paint coat has been removed from the composite surface. When the primer begins to show during the stripping operation as the paint is slowly removed, the PMB blast should be directed elsewhere on the surface to be stripped. This technique is essential in order to avoid damaging the composite material.
- b. Fiber Glass, Arranged Fiber ("Kevlar")/Epoxy, and Graphite or Boron Fiber/Epoxy Composite Surfaces. Plastic Media Blasting (PMB) shall be used to remove paint from composite surfaces whenever possible. PMB procedures for composite surfaces should follow those outlined in Section 2-16 of this technical order. PMB shall be used in such a way so as only to remove the paint coat and leave as much of the original primer on the surface as possible. If PMB is an unavailable or unauthorized method, refer only to paragraph 2-13b(1) below to remove only the paint coat. If repairs which require the total removal of the paint and primer are required to be made to the composite material, refer

to TO 1-1-690 for additional procedures and precautions, and then remove the finish system as outlined in the following paragraphs 2-13b (1), (2), and (3):

**WARNING**

Finish system removal using motor driven abrasives can generate airborne particles and toxic dust which can injure personnel and create a possible dust explosion from paint and abrasive material dust. Work pieces and motorized equipment shall be properly electrically grounded, and personnel shall wear dust/particulate masks, goggles, gloves, and full sleeved shirts when using motor driven abrasives. Consult Bioenvironmental Engineering Services for respiratory and ventilation requirements.

**NOTE**

The following procedures are not applicable to radomes. Finish system removal from radomes shall be accomplished per instructions in TO 1-1-24.

(1) Abrade the finish system topcoat from the surface down to the primer with hand held Specification MIL-A-9962, Type I, Class 1, Grade C (medium) aluminum oxide/nylon mesh abrasive mats or Specification GGG-C-520, Type II, Class 1, 150 grit, silicon carbide, open mesh abrasive cloth (NSN 5350-00-865-5687/25 ea 9 in. x 11 in. sheets) or either a random orbital tool or pneumatic drill motor (10,000 rpm max) fitted with a medium grade "Scotch-Brite" aluminum oxide/nylon mesh roloc or hook and loop mounted surface conditioning disc (3M Corp; Building Service and Cleaning Products Div, St. Paul, MN 55144) or a disc fabricated from the 150 grit Specification GGG-C-520, Type II, Class 1, abrasive cloth sheet listed above. Use of a random orbital tool or a pneumatic drill motor fitted with the "Scotch-Brite" medium grade, aluminum oxide, surface conditioning disc is preferable as this method provides the fastest removal rate with the least possibility of damage to the composite substrate and the longest abrasive life due to the non-loading characteristics of this type of disc. Apply the least amount of pressure necessary to effectively remove the finish system topcoat and not

go through the primer and gouge or abrade the composite substrate.

(2) Abrade the primer from the surface using the same methods as used for the topcoat but with finer grade abrasives. Use a Specification MIL-A-9962, Type I, Class 1, Grade B (fine) abrasive mat or a Specification GGG-C-520, Type II, Class 1, 240 grit abrasive cloth (NSN 5350-00-174-0999/25 ea 9 in x 11 in sheets) for hand held abrasives and a "Scotch-Brite" fine grade aluminum oxide/nylon mesh roloc or hook and loop mounted surface conditioning disc or a disc fabricated from the 240 grit Specification GGG-C-520, Type II, Class 1, abrasive cloth sheet listed above for hand held abrasives. Again, the motor driven "Scotch-Brite" surface conditioning disc is preferred; and only enough pressure to effectively remove the primer without gouging or abrading the composite surface shall be applied.

(3) After all topcoat has been removed, vacuum, or water wash or use compressed air to remove all finish system and abrasive dust from the surface.

**2-14. MECHANICAL REMOVAL OF ORGANIC FINISH SYSTEMS.** These instructions apply to metallic structure only. Refer to paragraphs 2-13 and 2-16 for non-metallic structures. Mechanical removal methods include the use of hand held wire brushes, bonded abrasive papers or cloths, and abrasive mats; motor driven wire brushes, bonded abrasive paper or cloth discs, and abrasive mat discs and flap brushes; and abrasive blasting. Mechanical removal is recommended when use of chemical removers is impractical due to structural complexities and/or rinsing difficulties in an area being worked and/or local environmental restrictions. While these methods are very effective for finish system removal, they can cause severe damage to structure and equipment in a very short time if improperly used. Therefore, mechanical removal of finish systems shall be used only when specifically authorized and approved by the responsible Air Logistics Center (ALC) Aircraft System Program Manager or equipment/component item manager with the full knowledge of and in conjunction with the ALC Corrosion Program Manager. In addition, mechanical removal methods shall be restricted to only those areas for which they have been approved and shall be performed as directed by the instructions in this technical order.



**WARNING**

- Abrasive blasting, motor driven wire brush and motor driven abrasive disc operations create airborne particles that are hazardous to the eyes and the body.
- The dust created by either of these methods is hazardous to the respiratory tract, and noise produced by abrasive blasting is hazardous to the hearing. Coveralls with full length sleeves and gloves with gauntlets shall be worn by personnel performing either of these removal methods. Personnel using motor driven abrasives shall wear dust/particulate type face masks, goggles, and/or full face shields. Personnel performing abrasive blasting shall wear an abrasive blasting air-line/hood respirator and hearing protection meeting the requirements of AFOSH STD 161-1. Contact the Base Bioenvironmental Engineer for specifics on required protective equipment.
- Dust generated from abrasive, metal, and finish system particles during abrasive blasting, motor driven wire brush, or motor driven abrasive disc finish system removal operations creates the potential for a dust explosion. Use only pneumatic type motor driven equipment. Properly electrically ground all motor driven equipment, abrasive blasting equipment, work stands, and work pieces when engaged in these operations. Avoid all sources of ignition where these operations are in progress, and provide adequate ventilation in the area.
- Abrasive blasting, motor driven wire brush, or motor driven abrasive disc finish system removal on steel and titanium alloy surfaces may cause sparking. Perform these operations in a well ventilated area, and take proper fire safety precautions. If these methods are being used in a large operation involving other types of metals, remove the finish system from the steel and titanium surfaces first; and then proceed to the other areas.

**CAUTION**

- Low carbon steel brushes shall not be used on aluminum, magnesium, copper, stainless steel, or titanium alloy surfaces as steel particles will embed in these surfaces and later rust or cause galvanic corrosion of these surfaces. Copper, brass, or beryllium copper brushes shall not be used on aluminum, magnesium, steel, stainless steel, or titanium alloy surfaces as they will smear on these surfaces and cause galvanic corrosion.
- Mechanical methods shall be used only long enough to remove the finish system and not abrade the underlying metal surface. Speed of removal is not the most important factor. Removal without damage to the metal surface or creating a condition which can lead to future corrosion damage and providing a surface suitable for finish system reapplication are the most important factors.
- When using mechanical methods, abrasive blast media and pieces of broken brushes and discs can escape from the work area. These methods shall not be used in areas or under conditions that allow escaped particles to enter into and damage or contaminate any system, engine, or other component. Barriers shall be erected around the work area and/or masking of the surrounding area and masking or plugging of all holes leading to the interior of systems and equipment shall be accomplished to prevent damage to and contamination of systems and equipment by dust, abrasive blast media, and pieces of broken brushes and discs. The system peculiar aircraft corrosion manual (-23) or the specific equipment manual shall be consulted for proper masking for mechanical finish system removal.
- Protective clothing worn during abrasive blasting operations shall remain in the work area and shall not be taken home for cleaning.

2-15. MECHANICAL REMOVAL PROCEDURES. For any and all mechanical finish system removal operations, prior approval for the operation shall be obtained from the responsible ALC as directed in

paragraph 2-14; the area involved in the operation shall be thoroughly cleaned to remove all oil, grease, and hydraulic fluid per TO 1-1-691; masking shall be accomplished per instructions in paragraph 2-4.g. of this manual and the applicable system or equipment peculiar manual prior to starting the operation; and the precautions listed in the cautions and warnings in this manual, the applicable system or equipment peculiar manual, and TO 1-1-691 shall be strictly followed. The methods for mechanical removal of a finish system depend on the type of metal from which it is to be removed and shall be in accordance with one of the following procedures.

#### NOTE

Damage to Clad, Alclad, or Anodize surfaces will reduce the corrosion protection in those areas.

#### a. Clad/Alclad and Anodized Aluminum Alloys:

(1) Use one of the following mechanical removal methods:

(a) Abrade the finish system topcoat from the surface down to the primer with hand held specification FF-W-1825, Type IV, Class 1, Form A or A-A-1044 Type II, Class 1 Form A Aluminum Wool (NSN 5350-00-286-4851 or 5350-00-312-6129 for 25 ea one pound rolls), specification MIL-A-9962, Type I, Class 1, Grade C (medium) aluminum oxide/nylon mesh abrasive mat (NSN 5350-00-697-5092/10 ea 9 in. x 11 in. sheets), or specification GGG-C-520, Type II, Class 1 150 grit, silicon carbide, open mesh abrasive cloth (NSN 5350-00-865-5687/25 ea 9 in. x 11 in. sheets) or either a random orbital tool or pneumatic drill motor (10,000 rpm max) fitted with a medium grade "Scotch-Brite" aluminum oxide/nylon mesh rolac or hook and loop mounted surface conditioning disc (3M Corp; Building Service and Cleaning Products Div., St. Paul, MN 55144) or a disc fabricated from the 150 grit specification GGG-C-520, Type II, Class 1 abrasive cloth sheet listed above. Use of a random orbital tool or a pneumatic drill motor fitted with the "Scotch-Brite" medium grade, aluminum oxide, surface conditioning disc is preferable as this method provides the fastest removal rate with the least possibility of damage to the metal substrate and the longest abrasive life due to the non-loading characteristics of this type of disc. Apply the least amount of pressure necessary to effectively remove the finish system topcoat and not go through the primer and gouge or abrade the metal substrate. Abrade the primer from the surface using the same methods as used for the topcoat but with finer grade abrasives. Use a specification MIL-A-9962, Type I,

Class 1, Grade B (fine) abrasive mat (NSN 5350-00-697-5093/10 ea 9 in. x 11 in. sheets) or a specification GGG-C-520, Type II, Class 1, 240 grit abrasive cloth (NSN 5350-00-174-0999/25 ea 9 in. x 11 in. sheets) for hand held abrasives and a fine grade "Scotch-Brite" aluminum oxide/nylon mesh rolac or hook and loop mounted surface conditioning disc or a disc fabricated from the 240 grit specification GGG-C-520, Type II, Class 1, abrasive cloth sheet listed above for motor driven abrasives. Again, the motor drive "Scotch-Brite" surface conditioning disc is preferred, and only enough pressure to remove the primer without gouging and abrading the metal substrate shall be applied.

(b) Plastic Media Blast. Unless specifically authorized in system specific tech data, this method is for depot level operations only. Abrasively blast the finish system from the surface using the plastic media blasting (PMB) technique in accordance with instructions in paragraph 2-16 and the aircraft system peculiar corrosion manual (-23) or the applicable equipment manual. Section V of TO 1-1-691 shall also be consulted for other helpful information on abrasive blasting.

(2) After the finish system has been removed, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the area.

#### b. Non-Clad and Unanodized Aluminum Alloys:

(1) Use one of the following mechanical removal methods:

(a) Use the same hand held abrasive or motor driven abrasive techniques used for clad and anodized aluminum alloys. For heavy structure such as floor beams, stringer extrusions, and rib forgings, hand held and motor driven aluminum or stainless steel wire brushes and a motor driven fine or medium grade "Scotch-Brite" aluminum oxide coated nylon mesh abrasive flap wheel may also be used.

(b) Plastic media blasting is a depot level operation only unless otherwise specified in weapon system specific tech data, use the same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys.

(2) After the finish system has been removed, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the equipment which was stripped.

#### c. Magnesium Alloys:

<b>WARNING</b>
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Magnesium particles, powder, or dust are extreme fire hazards. Motor driven wire brushes and abrasive flap brushes and abrasive blast media other than that listed below shall not be used for finish system removal from magnesium alloy surfaces. Keep work area clean. Do not permit flammable materials or any source of ignition in the area.

(1) Use one of the following mechanical removal methods:

(a) Use the same hand held abrasive techniques used for clad and anodized aluminum alloys.

(b) Plastic media blasting is a depot level operation only unless otherwise specified in weapon system specific tech data, use the same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys.

(2) After the finish system has been completely removed, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the equipment which was stripped.

d. Iron and Steel Alloys (Other Than Stainless Steel):

(1) Use one of the following mechanical removal methods:

(a) Use the same hand held abrasive or motor driven abrasive techniques used for clad and anodized aluminum alloys except that a metallic wool, if used, shall be specification FF-W-1825, Type I, Class 1, Form A, low carbon steel wool only (NSN 5350-00-242-4404/1 pound roll) and hand held and motor driven wire brushes may be used and shall be low carbon steel only.

(b) The same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys may be used for depot level operations only unless otherwise specified in the weapon system specific tech data. However, the use of other blasting media such as aluminum oxide, steel grit, and sand are much more effective on low carbon steels and iron because they will also remove rust/corrosion from the surface and leave it in a bright metal condition. When these other blasting media are used, the air pressure at the machine shall not exceed 40 psi for a pressure type machine. Section V of TO 1-1-691 shall be used as the controlling data for the operation, and metals with a thickness of 0.0625 inch or less shall not be blasted with these media.

(2) After the finish system has been completely removed, vacuum, water wash or use compressed air to remove all dust and abrasive residue from the area which was stripped.

e. Stainless Steel (CRES) and Nickel Based Alloys:

(1) These metals are not normally painted; but if they are and the finish system must be removed, use one of the following mechanical methods:

(a) Use the same hand held abrasive or motor driven abrasive techniques used for clad and anodized aluminum alloys except that a metallic wool, if used, shall be specification FF-W-1825, Type II, Class 1, Form A stainless steel wool only (NSN 5350-00-440-5035/1 pound roll) and hand held and motor driven wire brushes may be used and shall be stainless steel only.

(b) Plastic media blasting is a depot level operation only unless otherwise specified in weapon system specific tech data, use the same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys.

(2) After completing mechanical removal, polish the surface with hand held specification MIL-A-9962, Type I, Class 1, Grade A (very fine) aluminum oxide/nylon mesh abrasive mat (NSN 5350-00-967-5089/10 ea 9 in. x 11 in. sheets) or either a random orbital tool or pneumatic drill motor (10,000 rpm max) fitted with a very fine grade "Scotch-Brite" aluminum oxide/nylon mesh roloc or hook and loop mounted surface conditioning disc (3M Corp Building Service and Cleaning Products Div.; St. Paul MN 55144).

(3) After the surface has been polished, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the area which was stripped.

f. Copper and Copper Based Alloys:

(1) Use one of the following mechanical removal methods:

<b>CAUTION</b>
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Motor driven wire brushes and discs and abrasive blasting shall not be used on flexible, braided copper wire, cables, hoses, and lines as these methods can cause severe damage to these components.

(a) Use the same hand held abrasive or motor driven techniques used for clad and anodized aluminum alloys except that a metallic wool, if used, shall be specification FF-W-1825, Type III, Class 4, Form A, copper wool only (NSN 5350-00-255-7736/1

pound roll) and hand held and motor driven wire brushes may be used and shall be brass or copper only.

(b) Plastic media blasting is a depot level operation only unless otherwise specified in weapon system specific tech data, use the same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys.

(2) After the finish system has been completely removed, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the area which was stripped.

g. Titanium Alloys:

(1) Use one of the following mechanical removal methods:

(a) Use the same hand held abrasive or motor driven abrasive techniques used for clad and anodized aluminum alloys except that metallic wools, if used, shall be specification FF-W-1825, Type II, Class 1, Form A, stainless steel only (NSN 5350-00-440-5035/1 pound roll) and hand held and motor driven wire brushes may be used and shall be stainless steel only.

(b) Plastic media blasting is a depot level operation only unless otherwise specified in weapon system specific tech data, use the same abrasive blasting (PMB) techniques used for clad and anodized aluminum alloys.

(2) After the finish system has been completely removed, vacuum, water wash, or use compressed air to remove all dust and abrasive residue from the area which was stripped.

2-16. FINISH SYSTEM REMOVAL BY PLASTIC MEDIA BLASTING (PMB) METHOD. PMB is an excellent and rapid method for finish system removal, but it can cause severe damage to structure and injury to personnel if not done properly with the right type of equipment in the right type of facility. In addition, proper waste management must be ensured for economic and environmental reasons. Some types of materials and material thicknesses cannot be plastic media blasted under any circumstances. Therefore, PMB is authorized at depot and field level operations contingent upon SPM approval of facilities, personnel training and processes as specified in system/item specific technical data. These instructions are not intended to be all inclusive but are general necessary guidelines to be used in conjunction with additional instructions in applicable system peculiar aircraft or equipment manuals. All PMB finish removal operations shall conform to the following requirements.

a. Media Type. Media used in PMB shall be fabricated from plastic stocks which are free from high density particle contamination and other impurities. The plastics used shall be of a specific, non-changing chemical composition as specified in MIL-P-85891, Plastic Media, For Removal of Organic Coatings, and paragraphs 2-16.a.(1) through (5) of this TO. Media used in PMB shall have a particle size of U.S. screen 20 to 40 mesh, however, 12 to 16 mesh may be added as make up media. The media shall have a particle shape which is irregular with sharp, angular edges and corners. Plastic media are classified by type which specifies the hardness and plastic and, therefore, the performance characteristics. The following are the definitions of media types as specified by MIL-P-85891:

(1) Type I - A polyester plastic with a 3.0 mohs (34 to 42 Barcol) hardness. This media is recommended for use on aerospace equipment and shall be used if a 1/2 square foot per minute strip rate can be maintained under the aerospace stripping parameters listed in paragraph 2-16.e. Type I media is the least damaging of all media types.

(2) Type II. A Urea Formaldehyde based plastic with a 3.5 mohs (54 to 62 Barcol) hardness. This media may be used on aerospace equipment if and only if the Type I material produces less than a 1/2 square foot per minute strip rate under the parameters listed in paragraph 2-16.e. Parameters for the proper use of Type II media on aerospace structures are also listed in paragraph 2-16.e. Type II media are recommended for use on non-aerospace equipment such as AGE. For non-aerospace use blast pressure shall not exceed 50 psi on materials at least 0.040 inches thick. The nozzle shall be held at least 12 inches from the material to be stripped.

#### NOTE

The Type II media is more aggressive than the Type I media and will induce greater residual stresses in the metals on which it is used if it is used improperly. Increased residual stresses can cause warping and increased crack growth rates in aircraft skin materials and ground equipment enclosures.

(3) Type III. A Melamine Formaldehyde Plastic with a 4.0 mohs (64 to 74 Barcol) hardness. This Type III media are not authorized for use in stripping aerospace structures. Type III media are very aggressive and are recommended for stripping iron based equipment where residual stress problems will have no consequences. This material is authorized for use on AGE and other non-aerospace applications where the metal is at least

0.040 inches thick. Blasting pressure should not exceed 40 psi at the nozzle. The nozzle shall be held at least 12 inches from the material to be stripped.

(4) Type IV. A Phenol Formaldehyde Plastic with a 3.5 mohs (54 to 62 Barcol) hardness. Type IV is not authorized for blasting of aerospace structures however it may be used on AGE and on other non-aerospace equipment. Blast parameters are the same as for Type II materials.

(5) Type V. An Acrylic Plastic with a hardness of 3.2 moh (49 to 57 Barcol) hardness. This material is authorized for use on aerospace systems as well as non-aerospace applications. Blasting parameters: pressure = 25-40 psi; standoff distance = 12" - 24"; angle (alclad and composites) = 0 - 60 degrees; angle (nonclad) = 30 - 90 degrees.

b. Media Authorized for Air Force Use. Plastic media, while meeting the above criteria, can vary from manufacturer to manufacturer. The media listed below have been tested and meet Air Force requirements for use on aerospace and non-aerospace structures (where authorized in 2-16.a.). In addition, media conforming to the first article requirements of MIL-P-85891 are also authorized for use on aerospace and non-aerospace structures (where authorized in 2-16.a.). The authorized media are:

(1) Type I

- (a) U.S. Technology Corporation,  
Polyextra (Type I)  
79 Connecticut Mills Ave.  
Danielson CT 06239
- (b) Select-Tech, Inc.  
Aerolyte 3.0, (Type I)  
P.O. Box D  
Wallkill NY 37920
- (c) Patent Plastics, Inc.  
X-OFF (Type I)  
SFC-1412  
638 Maryville Pike, SW  
Knoxville TN 37920

(2) Type II

- (a) Perstorp Compounds, Inc.  
PERSTRIP Type UFM  
238 Nonotuck Street  
Florence MA 01060
- (b) Select-Tech, Inc.  
Aerolyte 3.5 SP (Type II)  
P.O. Box D  
Wallkill NY 37920
- (c) Patent Plastics, Inc.  
X-OFF (Type II)  
SFC-1734  
638 Maryville Pike, SW  
Knoxville TN 37920

- (d) Composition Materials Co.  
Type II Urea  
1375 Kings Highway East  
Fairfield CT 06430
- (e) Maxi-Blast, Inc.  
630 E. Bronson St.  
South Bend, IN 46601
- (f) AC Molding Compounds  
CYSTRIP U, Type II  
P. O. Box 425  
Wallingford CT 06492
- (g) Poly-Pacific Inc.  
DYNA-CUT M85891-2B6-2030  
8918 18 st.  
Edmonton Alberta T6P1K6
- (h) BIP Plastics, Limited  
Popes Lane  
Oldsbury Warley  
West Midlands, England B694PG
- (i) T & N Technology, Ltd  
Cawston House  
Cawston, Rugby  
Warwickshire, England UK  
CB227SA

(3) Type III

- (a) Composition Materials Co.  
Type III Melamine  
1375 Kings Highway East  
Fairfield CT 06430
- (b) Perstorp Compounds, Inc.  
PERSTRIP Type UFM  
238 Nonotuck Street  
Florence MA 01060

(4) Type IV

Select-Tech, Inc.  
Aerolyte 3.5 (Type IV)  
P.O. Box D  
Wallkill NY 37920

(5) Type V

- (a) Solidstrip, Inc.  
Type L, Solid Strip, Type V  
601 Interchange Boulevard  
Newark DE 19711
- (b) Composition Materials Co., Inc.  
Plasti-Grit, Type V  
1375 Kings Highway East  
Fairfield CT 06430
- (c) US Technology Corp.  
Poly V, Type V  
79 Connecticut Mills Av  
Danielson CT 06239

(e) Patent Plastics  
X-OFF, SFC 1620, Type V  
ATTN: Mr. Callahan  
638 Maryville Pike S.W.  
P.O. Box 9246  
Knoxville TN 37920

(f) Aerolyte Systems  
Type V, QC #A-20010-C  
ATTN: Sales Dept.  
1657 Rollins Road  
Burlingame CA 94010

c. Media Contamination Level. Media having a high density particle contamination may decrease the overall fatigue life of fatigue critical; thin skin materials which are stripped using PMB. It is generally recognized that fatigue sensitive aluminum and magnesium alloys less than .060 inches thick are susceptible to this type of degradation. Therefore, media not meeting the high density contamination levels outlined in this section will not be used on USAF equipment and must be purged from blasting equipment and replaced with media conforming to these requirements. There are many types of high density contaminants which can be introduced into blast media during both manufacture and use. The major types of contaminants are:

(1) sand, glass, and other silicate based materials

(2) aluminum, magnesium, iron, and zinc based metals

(3) paints and sealants

(4) high density plastics

d. As different contaminants effect the fatigue life in varying ways, it is difficult to list an overall high density particle contamination level which is not to restrictive of the entire process. Therefore, the contamination level test procedures are a culmination of tests which will allow the user to identify the quantity and class of contaminants. Prior to use, each batch/lot or a composite mixture of several batches/lots of new media shall be sampled and tested for contamination level. In addition, the media in use in the PMB facility shall be sampled and tested for contamination level every 80 hours of equipment operation time or after each aircraft or large piece of aerospace equipment is blasted (whichever is longer). Non aerospace equipment such as

- (d) AC Molding Compounds  
CYSTRIP A or CONLOG, Type V  
P.O. Box 425  
Wallingford CT 06492
- (e) Patent Plastics  
X-OFF, SFC 1620, Type V  
638 Maryville Pike S.W.  
P.O. Box 9246  
Knoxville TN 37920
- (f) Select-Tech Inc.  
Aerolyte Type V, Grade A  
P.O. Box D  
Wallkill NY 37920
- (g) Poly-Pacific Inc.  
Acrylic (Type V) with Anti-Stat  
8918 18 St.  
Edmonton Alberta T6P1K6
- (h) American Reclaiming Co.  
Acrylic, Type V  
4403 St. Lawrence Av.  
Cincinnati OH 45205

c. Media Contamination Level. Media having a high density particle contamination may decrease the overall fatigue life of fatigue critical; thin skin materials which are stripped using PMB. It is generally recognized that fatigue sensitive aluminum and magnesium alloys less than 0.060 inches thick are susceptible to this type of degradation. Therefore, media not meeting the high density contamination levels outlined in this section will not be used on USAF equipment and must be purged from blasting equipment and replaced with media conforming to these requirements. There are many types of high density contaminants which can be introduced into blast media during both manufacture and use. The major types of contaminants are:

- (1) sand, glass, and other silicate based materials
- (2) aluminum, magnesium, iron, and zinc based metals
- (3) paints and sealants
- (4) high density plastics

d. As different contaminants effect the fatigue life in varying ways, it is difficult to list an overall high density particle contamination level which is not too restrictive of the entire process. Therefore, the contamination level test procedures are a culmination of tests which will allow the user to identify the quantity and class of contaminants. Prior to use, each batch/lot or a composite mixture of several batches/lots of new media shall be sampled and

tested for contamination level. In addition, the media in use in the PMB facility shall be sampled and tested for contamination level every 80 hours of equipment operation time or after each aircraft or large piece of aerospace equipment is blasted (whichever is longer). Non aerospace equipment such as AGE and vehicles are less sensitive to media contamination and therefore media used to strip these items should be tested for contamination every 800 hours of equipment operation. Media found to have a high density particle contamination level greater than what is given below shall be purged from the system and replaced with new media. Testing at ALCs should be accomplished by the physical sciences laboratory (XX-ALC/TIXX). Testing at contractor and field level activities may be accomplished locally in a designated area adequately equipped to run the test for contamination. Determine the contamination level in accordance with the following procedure:

- (1) Equipment/Materials Recommended:
  - (a) One 500 milliliter separatory funnel
  - (b) Rod stand, for separatory funnel
  - (c) Holding rings, for funnels
  - (d) Perfluorohexane, 3M Company Part No. PF-5060
  - (e) n-Hexane, reagent grade
  - (f) One glass funnel, 3 - inch nominal diameter
  - (g) One glass powder (large stem) funnel, 4-inch nominal diameter
  - (h) Whatman number 42 (or equal) filter paper, 12.5 cm, to fit above funnel
  - (i) Scales, 1000 grams capacity, 0.1 gram sensitivity  
(reference: Ohaus E4000, 0-4000g, 0.1g, \$895;  
Sartorius U3600, 0-3600g, 0.1g, \$1075;  
Ohaus GT2100, 0-2100g, 0.01g, \$1495)
  - (j) Analytical balance, 100 grams capacity, 0.001 gram sensitivity  
(reference: Ohaus E120G, 0-120g/0.001g, \$995;  
Sartorius H120, 0-120g/0.001g, \$1125;  
Metler AB-160, 0-160g/0.0001g, \$2500;

Metler PM200, 0-210g/0.001g;  
Metler AT200, 0-205g/0.0001g,  
\$4095)

(k) Special dual range balances are available which offer bulk weighing and precision weighing in a single instrument. These may be substituted for the above two units, but usually have limited capacity and significantly higher prices.

(reference: Metler PM480 DeltaRange, 80g/0.001g, 410g/0.01g;  
Melter AT460 DeltaRange, 62g/0.0001g, 405g/0.001g, \$4095)

- (l) 500-600 ml tall form Pyrex beaker
- (m) 250 ml Pyrex beaker
- (n) 500-ml graduated glass cylinder
- (o) Two jug-type glass storage bottles, 1-gal, with screw caps
- (p) Hydrometer, 1.60 - 1.80 specific gravity
- (q) Pyrex watch glass, 75-90mm dia
- (r) Nalgene polyethylene wash bottles, 250 ml
- (s) Specimen forceps
- (t) Spatula, stainless steel
- (u) Glass stirring rods, 10 inch
- (v) Neoprene gloves, size as required  
(reference item: Playtex neoprene)

#### NOTE

Laboratory implements may be purchased from national laboratory supply firms such as Fisher Scientific, VWR Scientific, Curtin Matheson Scientific, or from local laboratory supply firms found in most large cities.

(2) Sampling Procedure: Collect approximately two liters of media.

(a) Used Media: The best representative sample is obtained by collecting media directly from the blast nozzle; but if this is not feasible, collect the sample from media hoppers (located after separation equipment in recovery/reclamation system).

(b) New Media: The best representative sample is obtained by agitating shipping container to thoroughly mix media prior to sampling, but this will probably be difficult due to the size and weight of most media shipping containers. Therefore, the

new media sample may be taken from the shipping container without agitation if necessary.

#### (3) Contamination Test Procedure:

(a) Ensure all glassware is clean and dry.

#### WARNING

Use caution when using solvents. Keep away from heat and open flame. Keep container closed. Use only with adequate ventilation. Avoid prolonged or repeated contact with skin. Avoid swallowing.

(b) Prepare a mixture of 5 percent by volume hexane and 95 percent by volume perfluorohexane, 3M Company Part No. PF-5060. In order to facilitate mixing, add n-hexane to the mixing vessel first, then add the PF-5060 fluid. The function of the perfluorohexane is to separate any dense particles from the plastic media. The specific gravity of the perfluorohexane is high enough to float the light plastic media while permitting any dense particles to settle. The purpose of the hexane is to resolve a problem with particles adhering to the sides of the separatory funnel in the following procedure. Care must be taken not to exceed the 5 percent content of hexane because it reduces the specific gravity and affects the flotation property of the mixture. The specific gravity of the mixture should read approximately 1.66 as determined with a hydrometer, but should never be below 1.60. A quantity of the mixture may be prepared in advance and stored until needed; however, storage should be in an appropriate small-neck storage bottle with a tight fitting cap.

(c) Add approximately 300-350 ml (bulk dry volume) of sample media to 500 ml beaker. Weigh beaker and media to the nearest tenth gram (0.1 gm) and record (Weight #1) gross weight. Pour media into 500 ml separatory funnel (stopcock closed) and ensure there is no spillage. Obtain tare weight of 500 ml beaker and record (Weight #2) to the nearest tenth gram (0.1 gm).

(d) Add the fluid to separatory funnel leaving some air space in the funnel for ease of agitation. Swirl the mixture. A swirling motion is more appropriate than shaking to reduce entrainment of air and suspension of particles due to energy of motion of the moving fluid. Media samples may contain some dust sized particles which may be suspended in the fluid after agitation. Tapping the side of the funnel should dislodge any



particles adhering to the sides. Place the separatory funnel on the rod stand using the holding ring. Allow 10 minutes for the suspended dust to settle or rise. Higher density particles will accumulate in the bottom of the separatory funnel on top of the stopcock.

(e) Fold the filter paper in a standard filter fold and place it in funnel. Position the filtering funnel in a holding ring on the rod stand beneath the separatory funnel and place a beaker beneath the filtering funnel to catch the test fluid. Higher density particles will be settled out in the bottom of separatory funnel (on top of stopcock). Use short duration opening of stopcock in order to drain higher density particles into filter funnel. Tapping the side of the separatory funnel may help to remove the high density particles. Do not allow fluid level to get too low, which might allow some floating media to be deposited with the high density contaminants. Additional fluid may be added to separatory funnel. Take care not to agitate mixture. If agitation occurs, allow 10 minutes for suspended dust particles to float/settle prior to continuation of decantation. To separate all of the high density particles, the process has to be repeated until no particles will separate out of the plastic media. One attempt will not extract them all.

(f) Place the filter and filtrate in a vented, dust free location (preferably, a laboratory hood) to dry for one hour. Measure the weight of the filter paper and filtrate to 0.001 gm precision. Allow the filter paper to dry an additional 30 minutes and reweigh. If there is a change greater than 0.001 gm, continue to dry the sample, checking the weight every 30 minutes until the weight between intervals does not change. Obtain the tare weight of a watch glass, or on an electronic balance so equipped, reset the balance to 0 with the watch glass on the pan. Carefully remove the filtrate from the filter paper onto the watch glass by tapping. Unfold the filter paper and remove the remaining particles with a hard instrument, such as a metal spatula, until no visible sign of particles remain. Do not use a brush. Fine particles or dust may have impregnated the filter paper. This residue is not a major concern and may be disregarded because fine particles (less than 80 mesh, US Standard Sieve) are not damaging to aircraft materials or structure. Depending upon the balance used, weigh or calculate the weight of the dense particles to 0.001 gm precision and record as Weight #3.

(g) The mixed test fluid should be retained for reuse. Filter the used fluid mixture through a funnel with clean filter paper. Store in a

separate, small-neck, tightly closed and properly labeled container. Recheck specific gravity with a hydrometer to assure it is in the proper range prior to reuse.

#### (h) Calculations:

Gross weight of media and 500 ml beaker (Weight #1) minus tare weight of 500 ml beaker (Weight #2) equals net weight of media.

Weight #1 - Weight #2 = Media Weight

Weight #3 = Dense Particles Weight

The Dense Particles Weight divided by the Media Weight equals the weight fraction of dense particles in the sample. Multiply the weight fraction by 100 to find the weight percent of dense particles in the sample.

Dense Particles Wt

\_\_\_\_\_ X 100 = Percent

Media Weight

(i) The contamination level (percentage) is a measure of all possible heavy contaminants listed earlier in this section. The high density contamination level (percentage) is a measure of silicates and metal particles. The high density contaminants (sand and glass in particular) tend to cause the most fatigue life degradation. The level of high density particles shall not exceed 0.02 percent as calculated above when the media is used to strip aerospace equipment. The high density contaminant level shall not exceed 2 percent when the media is used to strip non-aerospace equipment such as AGE or vehicles.

e. Operational Parameters for Metallic Surfaces. All PMB operations for use on metallic surfaces shall conform to the following parameters:

(1) Pressure shall be within the range of 40 to 60 psi at the blast nozzle for 3.0 moh hardness media (Type I), within the range of 25 to 40 psi at the nozzle for 3.2 moh hardness media (Type V), and within the range of 20 to 30 psi at the nozzle for 3.5 moh hardness media (Type II). See paragraph 2-16.a. for recommended parameters for stripping AGE and vehicles.

(2) The blast nozzle tip to work surface standoff distance shall be within the range of 12 to 24 inches for 3.0 moh hardness media (Type I), within the range of 12 to 24 inches for 3.2 moh hardness media (Type V), and within the range of 18 to 30 inches for 3.5 moh hardness media (Type II). See paragraph 2-16.a. for recommended parameters for AGE and vehicles.

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(3) The angle of incidence between the blast nozzle and the work surface shall be within the range of 30 to 90 degrees for 3.0 moh hardness media (Type I), within the range of 30 to 90 degrees

for 3.2 moh hardness media (Type V), and within the range of 0 to 60 degrees for 3.5 moh hardness media (Type II). AGE and vehicles may be stripped at any angle.

(4) Usage Restrictions. PMB shall not be used on metal structures having a thickness less than 0.016 inch for 3.0 moh and 3.2 moh hardness media (Type I and V) and 0.032 inch for 3.5 moh hardness media. See paragraph 2-16.a. for restrictions pertaining to AGE and vehicles.

#### NOTE

When blasting close to masking on the work surface, the nozzle shall be held as close as possible to 90 degrees with the work surface to prevent undercutting of the masking materials.

f. Operational Parameters for Non-Metallic (Composite) Surfaces. All PMB operations for use on non-metallic surfaces (fiberglass, kevlar/epoxy, graphite/ epoxy, boron/epoxy, etc.) shall conform to the following parameters:

(1) Pressure shall be within the range of 30 to 60 psi at the blast nozzle for the 3.0 mohs hardness media (Type I) and within the range of 25 to 40 psi for the 3.5 mohs hardness media (Type II and Type V).

(2) The blast nozzle tip to work surface standoff distance shall be with the range of 12 to 24 inches.

(3) The angle of incidence between the blast nozzle and the work surface shall be within the range of 40 to 60 degrees (measured from the horizontal).

(4) In order to maintain a constant removal rate and to limit the amount of time which the PMB blast impinges on any given surface ("dwell time"), the following relationships are important to remember:

(a) As standoff distance increases (decreases), pressure should increase (decrease) in order to keep a constant removal rate.

(b) As the angle of incidence decreases towards 0° (increases towards 90°), the pressure should increase (decrease) in order to keep a constant removal rate.

#### CAUTION

When using the PMB method of paint removal on non-metal (composite) surfaces, it is important to limit the amount of time for which the surface is exposed to the PMB blast. In order to limit this "dwell time" and still allow paint to be removed, operators should use the primer coat as a "flag." That is, when the primer begins to become

visible during PMB stripping operations, the PMB blast should be aimed at another section of the surface to be stripped. This will result in all of the paint being removed and in only a portion of the primer being removed. Most importantly, this way of limiting the dwell time prevents damage from occurring to the surface if the composite material being stripped.

#### CAUTION

In order to minimize dwell time, avoid "low pressure-long standoff distance-shallow angle" combinations of parameters.

g. Operational Safety Requirements.

(1) All sources of ignition shall be kept a minimum of 50 feet away from the area when PMB is in progress.

(2) All blasting equipment, work stands, and the aircraft, equipment, or components being blasted shall be properly electrically grounded per TO 00-25-172 and the applicable aircraft or equipment manual during the entire PMB operation.

(3) All power shall be removed from the aircraft or equipment while PMB is in progress.

(4) Titanium and steel alloy surfaces will spark when subjected to PMB. When a PMB operation involves a combination of these and other metals, the titanium and steel alloy surfaces shall be blasted first; and then the other metal surfaces shall be blasted.

(5) The facility used for PMB shall have adequate air flow/ventilation to prevent build up of an explosive dust mixture. The Base Bioenvironmental Engineer shall be consulted for proper ventilation requirements.

(6) Personnel involved in PMB shall wear coveralls with full length sleeves, gloves with gauntlets, and full air supplied respirator type hoods and hearing protection which meet AFOSH STD 161-1 and AFR 161-35 requirements. Hoods shall be put on prior to entering the blasting area and shall not be removed until after exiting the blasting area. Hoods shall be stored in a clean dust free area and shall be cleaned to remove all dust accumulations on them prior to storage after each use. All personnel entering the blasting area while PMB is in progress, even though not involved in the operation, shall also comply with these personnel protection requirements. The local BES will define the PMB blasting area when the PMB equipment is located

within a larger facility and is not segregated from other areas. Protective clothing worn during PMB shall remain in the work area and shall not be taken home for cleaning.

(7) Blast nozzle operators shall never direct a nozzle at other personnel. If more than one blast nozzle operator is involved in an operation at the same time, they shall be located on opposite sides and/or ends of the aircraft or equipment being blasted to ensure safe separation of personnel.

(8) Dust and media residue generated during PMB operations create very slippery conditions. Walking on top of aircraft or equipment during PMB operations shall be avoided if at all possible, and shall be done with extreme caution by personnel wearing fall protection devices if it is absolutely required by the operation. All work stands shall be equipped with guard rails to prevent falls.

h. Personnel Qualifications. PMB shall be performed only by personnel thoroughly trained in the operation of PMB equipment and thoroughly indoctrinated in and familiar with the PMB requirements and techniques specified in this technical order and any other system peculiar aircraft or equipment technical order applicable to the job to be performed.

i. Preblast Preparation.

(1) Prior to masking for PMB, the aircraft, equipment, or component shall be thoroughly cleaned per TO 1-1-691 to remove all grease, oil, hydraulic fluid, and dirt from surfaces to be blasted. Every effort shall be made to stop all fluid leaks noted at this time, and surfaces shall be allowed to fully dry prior to masking and input of the item into the blasting facility. Water and other fluids contaminate blasting media and may damage separation equipment.

(2) Prior to starting PMB, the aircraft, equipment, or component shall be properly masked to prevent blast media and dust from penetrating into interior areas and causing contamination or damage to equipment or systems or damage to structure which is susceptible to damage by media impingement. Masking shall be accomplished in accordance with instructions in paragraph 2-4.g. of this technical order and the applicable system peculiar aircraft or equipment technical order for the item being blasted such as the aircraft system peculiar -23 corrosion manual.

j. Postblast Cleaning. When the finish system has been completely removed by PMB all surfaces of the aircraft, equipment, or component shall be thoroughly vacuumed with a heavy duty, pneumatic

type, wet/dry vacuum cleaner to remove all finish system dust and media residue. As an alternative, compressed air or water wash may be used to remove dust and media residue. Masking shall be removed, and interior areas and crevices which were masked or plugged to prevent dust and media entry shall be inspected for presence of dust and media particles and vacuumed clean as necessary.

k. Specific Technical Data and Work Directives. Each aircraft system program manager or equipment item manager (XX-ALC/XX) shall prepare detailed masking instructions and blasting instructions that conform to all the requirements in this technical order and incorporate these instructions in the applicable system peculiar aircraft or equipment technical order, such as the aircraft system peculiar -23 corrosion manual, prior to initiating any PMB finish system removal operation on any aircraft, component, or piece of equipment. In addition, they shall prepare a detailed work specification/project directive that levies a requirement for PMB finish system removal in accordance with the technical data on their maintenance organization or contractor for each separate PMB finish system removal operation. Finally, a detailed step by step process order or work control document that complies with all the technical data and work specification/project directive requirements shall be prepared by their maintenance organization or contractor for each separate PMB finish system removal operation.

2-17. Selection and Use of Dip Tank Paint Removal Compounds.

a. Identify paint system to be removed per paragraph 2-4.c. of this TO.

b. Parts to be stripped must be clean in order to ensure the effectiveness of stripping operations. Clean parts in accordance with TO 1-1-691 prior to removal operations.

c. Tank Type Strippers.

**WARNING**

- Do not heat paint removers/strippers formulated for use at ambient temperatures. Extremely toxic vapors will result.
- Strict adherence to manufacturers instruction is required during use of paint removers/strippers to prevent toxic vapors.

**CAUTION**

Different manufacturer's materials are not compatible with each other. Do not mix. Do not add water or any other materials unless specifically required by the manufacturer. Failure to follow manufacturer's direction will result in damaged parts.

**CAUTION**

Mix thoroughly before pouring from manufacturer's container if amounts less than entire container are needed. This is necessary to ensure correct proportions of fume seal and stripping compound are maintained. Parts must be thoroughly dry before immersing in paint stripping solution. Ensure parts to be stripped are completely immersed in stripping material. Do not allow them to extend into seal layer or to protrude above surface of solution. Mixture of additional water other than recommended by manufacturer will result in damage to parts being cleaned; therefore, water rinse should be accomplished well away from paint stripping tank.

**NOTE**

During changeover to polyurethane system, there will be a mix of both systems. Paint strippers that are rated good for one system are only fair on the other system. The ideal situation would be to have one tank of paint stripper for each paint system. Where this is not feasible, it is recommended that tank stripper be augmented with brush on paint strippers from this TO.

(1) Strip polyurethane and acrylic-nitrocellulose paints using tank type paint remover per Specification MIL-R-83936 or brush-on paint removers as required. Tank type remover is available under MIL-R-83936, Type II, Hazardous Waste Reduction Formula from General Services Administration. It contains no ingredients which are presently classified as hazardous waste as defined by Congressional law 40 CFR 261 subparts C and D. Order this environmentally compliant material under NSN 8010-01-368-7878 (DR - 55 gallon).

(2) Ambient Temperature Polyurethane Paint Stripper (Tank Type), MIL-R-87978. The following strippers have proven satisfactory for removing polyurethane paint system; however, they are not stock listed and must be procured through local purchase.

**NOTE**

These strippers are to be used at ambient temperature only. DO NOT HEAT.

- (a) Eldorado Chemical Company, Inc.  
P.O. Box 32567  
San Antonio, Texas 78216  
Part No. CT-2603
- (b) Magnaflux Surface Conditioners, Inc.  
Union City, California 94583  
Part No. 3838
- (c) TABCO  
940 West 100 South  
Salt Lake City, Utah 84104  
Part No. 3001
- (d) Turco Products, Inc.  
7300 Bolsa Avenue  
Westminster, California 92684-3600  
Part No. 6542

(3) Acrylic-Nitrocellulose Paint Stripper (Tank Type). Use paint remover, Specification MIL-R-83936, "Remover, Paint, Tank Type; for Aircraft Wheels, Landing Gear Components, and Other Aircraft and Age Components" for removing paint from wheels coated with acrylic-nitrocellulose paint system. This material requires heated tanks with ventilation. There is a qualified products list and strippers can be ordered under NSN 8010-01-040-1059. Paint strippers qualified to Specification MIL-R-83936 are non-phenolic strippers for aluminum/ magnesium. These strippers have an inhibitor which prevents corrosion. The lack of inhibitors will have a rapid and most serious effect on magnesium parts. Stripping solutions that have inhibitor breakdown will not attack Specification MIL-M-3171 coating on magnesium parts but will corrode metal itself wherever Specification MIL-M-3171 coating is not present. This corrosion will initially be observed as a white powder residue around any scratches or pits on surface of metal after removing part from stripping solution. Inhibitor breakdown will be initially observed on aluminum parts when parts are removed from stripping solution and surface of metal appears to be dull or stained. When either of these conditions is observed, you must take one of the two following actions:

(a) Replenish with appropriate amount of inhibitors, determined through chemical laboratory analysis.

(b) Replace paint stripper with new paint stripper, Specification MIL-R-83936.

**WARNING**

Paint strippers should be used as received and heated to manufacturer's recommendation. Do not exceed recommended temperature as rapid deterioration and toxic vapors will result. Fume seal may be lost after prolonged usage. Additions to fume seal will be accomplished in accordance with manufacturer's instructions.

d. Dip Tank Paint Removal Procedures.

**WARNING**

- Do not heat polyurethane paint stripping compound. Toxic vapors will result.
- Wear protective gloves and chemical goggles/face shield to prevent skin and eye contact when immersing and rinsing parts.

**NOTE**

Stripping tanks will be checked once a week for pH level. Use approximately two inches of phydron testing paper, NSN 6630-00-442-9005; dip in solution for approximately 10 seconds. Remove and match color to scale on container. Discard any solution with a pH of 4 or less.

(1) Tank Type.

(a) Immerse part in paint stripper.

Ensure parts to be stripped are completely immersed in stripping material. Do not allow them to extend into seal layer or to protrude above surface of solution. After soaking for a maximum of four hours, scrub parts with bristle or fiber brushes. Wire brushes or steel wool will not be used. If required to remove stubborn areas of paint, procedure can be repeated up to a maximum of six times.

(b) Pressure spray and rinse parts thoroughly with water (warm water preferred) after removal from paint stripping compound.

(c) Allow parts to dry. Parts may be wiped with towels, rags, or forced air dried to remove excess moisture.

2-18. Finish System Removal by Medium-Pressure-Water (MPW) Stripping Method. This MPW

stripping method requires the use of medium-pressure water and bicarbonate of soda injection system with control, hoses, and hand-held with various nozzle configurations. The injection system shall consist of a positive feed control system, such as an auger/computer controlled system. This MPW stripping system, with or without abrasives is an excellent method for finish system removal, but can cause severe damage to structure and injury to personnel, if not done properly. The following areas: fiberglass panels, composite panels, radomes, spot-welded panels, external antennas, landing gear, and thin-skinned panels cannot be stripped with this method under any circumstances. The pressure water stripping is authorized at depot and field-level operations subject to SPM approval of facilities, equipment, personnel training, and technical data. These instructions are not intended to be all inclusive, but are general, necessary guidelines to be used in conjunction with additional instructions in applicable system-peculiar aircraft or equipment manuals. All pressure water stripping operations shall conform to the following requirements:

**NOTE**

Only the equipment and supplies listed below have been approved for Air Force use. The medium-pressure-water equipment are E25M Electric Unit, NSN 4940-01-413-5627 and the D44 Diesel Unit, NSN 4940-01-411-9826, without rotating gun. For a portable unit, a trailer can be used NSN 4940-01-413-5602. It is recommended to obtain the repair kit Model 900-005, NSN 4940-01-411-9829. The bicarbonate of soda blasting media is available in 40 pound bags NSN 5350-01-414-1894.

a. Stripping Preparation.

(1) Prior to masking for water stripping, the aircraft and other equipment shall be defueled and purged. In addition, if deemed necessary, the aircraft or extremely contaminated areas on the aircraft shall be washed in accordance with TO 1-1-691.

(2) Before starting water stripping operations, the aircraft, equipment, or component shall be properly masked and sealed to prevent water and/or bicarbonate of soda blast media from penetrating into interior areas and causing contamination or damage to equipment or systems or damage to structure. All surfaces where tape is to be applied shall be wiped down with isopropyl alcohol, TT-I-735 or polyurethane thinner, MIL-T-81772. The solvent used during the wipe down

operation shall not be allowed to evaporate from the surface. Instead, the solvent shall be wiped from the surface with a dry clean cloth. Masking shall be accomplished according to instructions in paragraph 2-4.g. of this technical order and the applicable system-peculiar aircraft or equipment technical order for the item being stripped, such as the aircraft system-peculiar -23 corrosion manual. Sealing putty (NSN 8030-01-363-8636) shall be used to seal storage compartments and protect all door gaskets/seals. In addition to masking and sealing such areas as fiberglass components, windows, radomes, and composite structures, drain holes shall be plugged prior to stripping.

(3) Areas which are covered by the barrier tape may be hand depainted with an environmentally compliant chemical remover (i.e. benzyl alcohol) prior to masking for the complete depainting operation provided in the procedures in TO 1-1-8, which shall be strictly followed. Narrow seams around emergency doors, hatches, entry doors, and other doors on the aircraft shall be protected from the blast stream by masking with sealing putty. This material cannot be used if the aircraft is exposed to sunlight and must be thoroughly removed immediately after the depainting operation is completed.

b. Stripping Operations. All pressure water stripping shall conform to the following parameters:

**CAUTION**

Bicarbonate of soda blast media shall not exceed one half pound per minute on the exterior of any aircraft.

(1) The stripping equipment shall have the following operating parameters: water pressure of 15,000 psi; water flow rate of 3 gpm, bicarbonate of soda blast media flow rate of one quarter pound per minute to 1/2 lb/min and corrosion inhibitor flow rate of gpm.

(2) The nozzle stand-off distance shall be within the range of 2 to 4 inches from the tip of the nozzle to the working surface.

(3) The angle of incidence between the strip nozzle and the work surface shall be within the range of 40 to 60 degrees (measured from the horizontal surface being stripped).

(4) In order to limit the amount of time which the water stripping strikes or hits any given surface (dwell time) and prevent possible damage, the nozzle shall be moving across the surface at a minimum rate of 4 inches every second.

c. Post Stripping Cleaning.

(1) When the finish system has been completely removed by the pressure water stripping method, all surfaces of the aircraft, equipment, or component shall be rinsed with hot water (not to exceed 140°F). If hot water is not available, additional rinsing is required to remove all media residue (white bicarbonate of soda powder).

(2) Remove masking and sealing materials and, if necessary, hand clean protected areas. Allow entire area to thoroughly dry. Open and flush all covers and/or crevices to eliminate media residue. The aircraft, equipment, or component shall be thoroughly washed in accordance with TO 1-1-691.

d. Operational Safety Requirements.

(1) All sources of ignition shall be kept a minimum of 50 feet away from the area when water stripping is in progress.

(2) All water stripping equipment, work stands, and the aircraft, equipment, or components being stripped shall be electrically grounded per TO 00-25-172 and the applicable aircraft or equipment manual during the entire stripping operation.

(3) All power shall be removed from the aircraft or equipment while water stripping is in progress.

(4) The facility used for water stripping shall have adequate air flow/ventilation. The Base Bioenvironmental Engineer shall be consulted for proper ventilation requirements.

(5) Personnel involved in water stripping shall wear ear plugs, ear muffs, goggles, or full face shield, wet-weather suit, water-resistant hoods, and chemical-resistant boots with a foot guard that will protect the entire foot from 15,000 psi water stream. All personnel entering the stripping area while water stripping is in progress, even though not involved in the operation, shall also comply with these personnel protection requirements. The local base bioenvironmental office shall define the water-stripping area when the pressure water-stripping equipment is located within a larger facility and is not segregated from other areas. Protective clothing worn during water stripping shall remain in the work area and shall not be taken home for cleaning.

(6) Water stripping nozzle operators shall never direct a nozzle at other personnel. If more than one water stripping nozzle operator is involved in an operation at the same time, they shall be located on opposite sides and/or ends of



the aircraft or equipment being stripped to ensure safe separation of personnel.

(7) Water and media residue generated during stripping operations can create a slippery condition. Walking on top of aircraft or equipment during stripping operations shall be avoided, if at all possible, and shall be done with extreme caution by personnel wearing fall protection devices, if it is absolutely required by the operation. All work stands shall be equipped with guard rails to prevent falls.

e. Personnel Qualifications. Water stripping shall be performed only by personnel thoroughly trained in the operation of pressure water stripping equipment and thoroughly familiar with the water stripping requirements and techniques specified in this technical order and any other system-peculiar aircraft or equipment technical order applicable to the job to be performed.

## SECTION III

## PREPAINT SURFACE TREATMENT AND APPLICATION OF COATINGS

## 3-1. PREPAINT SURFACE TREATMENT AND APPLICATION OF COATINGS INTRODUCTION.

3-2. The life, effectiveness and appearance of organic finishes will depend more on the condition of surfaces receiving them than any other factor. Most surfaces can be expected to present adverse painting conditions either inherent to the material, or imposed on it by the environment in the presence of foreign materials and/or contamination or corrosion. Presence of any of these factors will require treatment or removal action to make possible the proper application of organic coatings. The life and effectiveness of organic coatings are an integral part of corrosion prevention and control for aerospace equipment. The procedures contained herein are for preparation of aluminum and magnesium exterior surfaces after complete depainting and prior to complete repainting of an aircraft. TO requirements and procedures for prepaint preparation of metal surfaces, other than aluminum and magnesium, which may be used on aircraft exterior surfaces shall be complied with in addition to requirements of this manual.

## 3-3. SURFACE INSPECTION, UNPAINTED SURFACES.

3-4. A thorough inspection for corrosion shall be conducted over the entire surface to be painted. All areas requiring mechanical and chemical corrosion removal will be identified and marked.

## 3-5. CORROSION REMOVAL, CHEMICAL AND MECHANICAL.

3-6. All chemical and mechanical corrosion removal required for treatment of corrosion damage shall be accomplished in accordance with the System Peculiar Corrosion Control Technical Order and TO 1-1-691. All corrosion removal and treatment shall be accomplished prior to performing prepaint processes in this manual.

**NOTE**

All work requirements, repairs, mechanical corrosion removal, and sealing requirements (sealant cured completely) shall be completed, inspected, and have all defects corrected prior to prepaint cleaning and surface preparation. Failure to comply with the above requirement will cause paint adhesion problems and severe delays in painting operations.

## 3-7. PREPAINT TREATMENT, UNPAINTED SURFACES.

3-8. Prior to application of corrosion removal compounds on aluminum or magnesium, all surfaces to be treated shall be thoroughly cleaned of dirt, grease, and contamination. Procedures outlined in TO 1-1-691, shall be followed to accomplish the cleaning.

3-9. A thorough inspection shall be conducted over the complete surface to be treated to ensure all foreign matter that may have been retained in seams, or oily deposits that may have accumulated during or after cleaning, have been removed. Also, all corrosion that is to be chemically treated during the prepaint surface preparation must be identified.

3-10. All surfaces shall be regarded as dirty even if there is no visible dirt. Carefully wash the aircraft per TO 1-1-691 prior to application of MIL-C-38334.

3-11. Water break tests shall be conducted on representative areas to be treated immediately prior to application of corrosion removal prepaint solutions.

**NOTE**

When an entire aircraft is to be treated, a quality assurance inspection shall perform an In-Process Inspection (IPI), using the water break test method, on representative surfaces of the aircraft to ensure the aircraft is properly cleaned prior to application of corrosion removal compounds.

## 3-12. WATER BREAK INSPECTION.

3-13. The following procedures shall be used to comply with the water break inspection. A mist of distilled or clean tap water is atomized on the surface to be coated employing any convenient small atomizing spray device. If the water gathers into discrete (separate) droplets within 25 seconds, that is, if the surface shows a water break within this time, the surface shall be considered as failing the test. If the water forms a continuous film by flashing out suddenly over a large area, it shall be considered as evidence of impurities on the surface such as free alkali, residual detergents, etc., and the surface shall also be considered as failing the cleanliness test. If the water drops coalesce (go together) into a continuous film of water without a sudden flash out and form a lense, then the surface shall be considered as having satisfactorily passed the water break test.

Any areas that fails the test shall be cleaned per TO 1-1-691, and reinspected.

3-14. During prepaint operations of acid etch and chromate conversion coatings, surfaces should also be monitored for evidence of undetected soiled areas. When accomplishing the rinse of etch or conversion coating solution and a rapid flash off or beading of the rinse water occurs, this indicates an unsatisfactorily cleaned area not detected during the random sample of the water break test. Areas which show evidence of inadequate cleaning during rinsing require recleaning and reaccomplishment of prepaint surface preparation.

### 3-15. CORROSION REMOVAL PREPAINT COMPOUND, ALUMINUM.

#### CAUTION

- Exposure of magnesium surfaces to aluminum prepaint chemicals will initiate corrosion which will continue even under a new paint system and ultimately cause severe damage.
- All magnesium surfaces, steel/high strength steel and cadmium plated surfaces shall be protected for MIL-C-38334 solutions.

3-16. Masking of all lap joints, hinges, faying surfaces, access doors, air scoops and other openings that would allow MIL-C-38334 to enter or be entrapped is required prior to beginning the prepaint process. also, masking of unprotected magnesium, steel and cadmium plated components shall be done at this time. Masking will be accomplished using waterproof barrier paper, specification MIL-B-131 and sealing tape, MIL-T-23397, Type II. The 3M Corp. No. 425 or No. 417 Tape has proven to be one of the most effective of these tapes for extensive complete aircraft repaint operations.

3-17. PREPAINT CHEMICAL CORROSION REMOVAL MATERIALS. Corrosion removal compound, prepaint specification MIL-C-38334 is used for removing oxidation and corrosion products from aluminum alloys which are not required to be Liquid Oxygen (LOX) Compatible. MIL-C-38334 is available in two types.

(1) Type I, liquid concentrate which is diluted with an equal amount of water before use.

(2) Type II, powdered concentrate kit, materials will be dissolved in the volume of water specified on the kit.

### 3-18. APPLICATION OF MIL-C-38334 SOLUTION/NOT LOX COMPATIBLE.

#### WARNING

MIL-C-38334 is moderately toxic to the skin, eyes and respiratory tract. Eye and skin protection is required. Good general ventilation is normally adequate.

3-19. Apply solution by flowing, mopping, sponging, brushing or wiping. The solution is more effective if applied warm (130°F 10°F), followed by vigorous agitation with a non-metallic, acid-resistant brush or aluminum-oxide-abrasive, nylon mat (MIL-A-9962, Type I, Grade A). When applying the solution to large areas, start at the lowest surface working upward. Applying the solution with a circular motion to disturb the surface film will assure proper coverage. Allow the solution to remain on the surface approximately 12 minutes, then rinse away with potable water. Corroded areas identified for treatment during the prepaint process may require additional agitation beyond that specified above. Corroded areas being treated during the prepaint may also require more than one application and rinse. Examine the areas being treated with a 4 to 10 power magnifying glass to determine if another application is required. MIL-C-5541/MIL-C-81706 chromate conversion coating shall be applied immediately after the final rinse, and before the surface dries.

#### NOTE

When a large area/aircraft is being treated with MIL-C-38334, start applying solution to lowest point first and work upward.

### 3-20. SURFACE TREATMENT MATERIALS FOR ALUMINUM.

3-21. Chromate conversion coating, specification, MIL-C-81706 are used on aluminum alloys as a prepaint treatment for most approved paint systems; repair of damaged anodic coatings; and treatment of corrosion rework areas on clad/unclad aluminum alloys. The specifications MIL-C-81706 coatings are not as abrasion-resistant as anodized coatings conforming to specification MIL-A-8625, even though they do provide an effective means for re-establishing the corrosion resistance of mechanically damaged anodic coatings in the field. Specification MIL-C-5541 covers two classes of films as follows:

- a. Class 1A - For maximum protection against corrosion.
- b. Class 3 - For protection against corrosion where low electrical resistance is required.

### 3-21A. NO-RINSE PROCESS FOR SURFACE TREATMENT OF ALUMINUM

a. This process is for applying conversion coating using a "wipe-on and blot-off" method. This procedure can be used in order to minimize hazardous waste water generated from the above application of MIL-C-81706 solutions.

b. Apply corrosion removal solution (MIL-C-38334, Type I, Class 1, diluted with an equal amount of water) by sponging, brushing, or wiping. The solution is more effective if applied warm (130°F ±10°F), followed by vigorous agitation with a nonmetallic, acid-resistant brush, aluminum-oxide-abrasive nylon mat (MIL-A-9962, Type I, Grade A), or scouring pads. Applying the solution with a circular motion will disturb the surface film and assure proper coverage. Allow the solution to remain on the surface approximately 12 minutes. Keep the surface wet during the entire 12 minutes. Rinse, using a clean cloth dampened with cold potable water. After rinsing with cold water, allow the water to evaporate until a thin film of water exists on the surface. Corroded areas identified for treatment during the prepaint may require more than one application and rinse. Examine suspect areas being treated with a 4 to 10 power magnifying glass to determine if another application is required. MIL-C-5541/MIL-C-81706 chromate conversion coating shall be applied immediately after the evaporation period.

c. Section 3-20 through 3-27 shall be complied with next prior to the "wipe-on and blot-off" method.

d. After allowing the aluminum part to dry to a damp surface, dampen a white cotton wiping rag with MIL-C-81706, Class 1A, Form III, corrosion conversion coating. Dampen the rag by slowly pouring the liquid onto the rag (this will keep the material uncontaminated and minimize the amount of material being used. The rag will have a yellowish color.

e. Wipe on the conversion coating to the still wet aluminum part. Apply the coating in a manner such that streaking is minimized and a thin uniform coat is developed. On areas where difficulty is experienced in getting the conversion coating to react with the aluminum, light abrading with a very fine or fine aluminum oxide nylon abrasive mat, specification MIL-A-9962A, dampening with MIL-C-5541/MIL-C-81706 will help overcome the difficulty. If dark brown spots or streaking occurs, lightly rub the area with fingers of your glove.

f. Allow the conversion coating to react with the aluminum until the aluminum turns a brassy,

iridescent yellowish tint. The reaction time should be at least 3 minutes, but not longer than 5 minutes.

g. Dampen a white rag in clean water and ring out the rag so it is not dripping with water. Blot all of the areas that have been conversion coated with the clean wet rag. The rag should become contaminated with the conversion coating, giving the rag a yellowish color. Repeat this procedure (starting with a clean rag) at least two more times so the surface has been blotted off at least three times. No visible coating residue (yellowish color) should be on the rag after the last blotting action.

h. Areas not properly coated (including those that are powdery) shall be recoated by reapplying fresh coating solution allowing it to react with aluminum until the aluminum turns a brassy iridescent yellowish tint.

i. Disposal of the contaminated rags, abrasive mats, and other materials shall be placed in the appropriate hazardous waste container.

j. TO 1-1-8, Section 3-38, and the remainder of TO 1-1-8, Section 8, shall be compiled with, as specified.

k. The coating should be allowed to air dry for 2 hours minimum or, if required, force-dried by blowing dry with warm, clean air (140°F maximum) for 1 hour prior to using part or overcoating with primer coating.

#### NOTE

Check with Bioenvironmental Engineering and Environmental Management for proper disposal of excess solution.

l. The final protective primer or primer/top-coat system shall be applied only on a completely dry surface but shall be applied within 48 hours after application completion of the MIL-C-81706 conversion coating. The reapplication of MIL-C-38334 corrosion removal compound and MIL-C-81706 chromate conversion coating will be accomplished if more than 48 hours have elapsed since the previous application.

3-22. Materials required for applying MIL-C-5541 conversion coating are covered by MIL-C-81706. The materials are provided in three forms: Form I - Concentrated Liquid, Form II - Powder, and Form III - Premixed Liquid. Each form can be applied by spray, brush or immersion. Materials for Class 1A chemical films are available in iridescent yellow or light brown, or dyed in specific colors. The prepaint treatment of aircraft surfaces

prior to repainting will be accomplished using specification MIL-C-5541, Class 1A coatings, using specification MIL-C-81706, color iridescent yellow.

3-23. The use of MIL-C-5541/MIL-C-81706 requires that the following precautions be observed.

### WARNING

- MIL-C-5541/MIL-C-81706 conversion coating materials are toxic and require the use of rubber gloves and eye protection (goggles and face shield) by personnel mixing or applying. If the material (which is an acid) accidentally contacts the skin or eyes, flush immediately with plenty of clean water. Report to dispensary and/or consult a physician if eyes are effected or skin is burned.
- Mixing an application shall be done in an adequately-ventilated area. Avoid prolonged breathing of vapors.
- Do not permit specification MIL-C-5541/MIL-C-81706 materials to come into contact with paint thinner, acetone, or other combustible materials, fire may result. Also, any absorbent materials, i.e., rags, sponges, paper, or nylon matting, etc., used in or exposed to these materials shall be rinsed in water before discarding. They are an extreme fire hazard if allowed to dry otherwise.

### CAUTION

- Do not use MIL-C-5541/MIL-C-81706 treatment on magnesium alloy, high strength steel, or on cadmium or zinc plated surfaces. If these materials are present in adjacent areas, they must be protected.
- Conversion coating material should not be allowed to center faying surface areas or other areas where the solution can not be adequately removed by rinsing.

### NOTE

The solution will usually turn green during application if dirt or corrosion

is present on the surface. The color green will not have the iridescent quality that a properly applied and dried solution will display.

3-24. MIXING MIL-C-81706 SOLUTION.

3-25. Select an area for mixing so spillage or splatter from solution will not cause damage to other equipment. Use only a stainless steel, plastic or rubber container to mix solution in. Mix only enough solution to coincide with the immediate job requirements in order that fresh materials will be available for each use.

3-26. If specification MIL-C-81706, Form II - Powder, is being used and it is not finely divided, crush by rolling on a clean piece of paper. This will improve mixing efficiency.

### WARNING

Nitric acid is highly toxic to skin, eyes, and respiratory tract. Eye and skin protection are required. Use only in a well-ventilated area. In case of eye or skin contact, flush immediately with water and report to dispensary.

3-27. Preparation and use of MIL-C-81706, Form II - Powder, will be done in accordance with vendors technical instructions. This solution should be analyzed prior to use for pH value and hexavalent chromium content by the base chemical laboratory at depot facilities. Solutions used in field operations can be analyzed using pH paper or a pH meter and visual performance characteristics. Solution should be retested every five days and the chemical laboratory should be consulted should difficulties arise. Field operations prepare solutions as per vendors instructions and test per example below. Three ounces of MIL-C-81706 powder to one gallon of clean water in an approved container. Add nitric acid, Federal Specification O-N-350 and check pH for range of 1.6 - 1.9 five millimeters will usually adjust pH to this range however, it could require up to 15 milliliters mix solution well with a clean plastic or aluminum paddle. Check the time it takes to form an iridescent yellow to brown color on a sample of the same alloy the solution will be used on. If the time is more than

5 minutes, retest the pH and make the following adjustments:

a. A pH greater than 1.9 will require addition of 2 ml portions of nitric acid until desired pH is achieved.

b. A pH less than 1.6 will require addition of 2 ml portions of ammonium hydroxide until the desired pH is achieved. After pH adjustment the solution reaction time should fall within the range of 1 to 5 minutes.

c. If powder material is being used, allow the solution to stand approximately 1 hour prior to application. A small amount of powder may not dissolve; however, this is not objectionable.

### 3-28. APPLICATION OF MIL-C-81706 SOLUTIONS.

3-29. Apply the coating solution with a fiber brush, clean rag/sponge applicator bottle (plastic) and/or low pressure stream (flow-on, do not atomize). The method used for application should be selected depending on the specific job requirement. If pumping is required, pumps, valves, and fittings shall be manufactured from 18-8 stainless steel, polypropylene or polyvinyl chloride (PVC). Flow on MIL-C-81706 solution immediately after rinsing the MIL-C-38334 compound from aircraft surfaces being repainted and while these surfaces are still wet. Allow the gross amount of rinse water to run off the aircraft, but do not wait for completed drying before applying MIL-C-81706 solution as the oxide film just removed by MIL-C-38334 compound will reform during this time period and prevent a proper take of the MIL-C-81706.

3-30. Wet or flood the surface to be treated and keep the surface completely wet with the solution until coating is formed. This will take from 1 to 5 minutes depending on the surface condition, the particular manufacturer's product being used, and the temperature. Begin application at the lowest surface then apply sideways and upward to prevent streaking.

3-31. On areas where difficulty is experienced in getting the coating to take light abrading with a very fine or fine aluminum oxide nylon abrasive mat, specification MIL-A-9962, soaked with the solution will help overcome the difficulty. If the surface is dirty, remove the dirt with the nylon mat and/or sponge. The mat and/or sponge used to remove the dirt should be rinsed in clean water and squeezed almost dry before wetting with stock coating solution for reapplication.

3-32. It will be noted during the initial coating application that there will be a tendency for dark (brown) spots to form on some areas. The formation of these spots can be prevented to some extent by

lightly rubbing with the fingers (gloves on). If the spots are allowed to form, the applicable areas shall be abraded with the nylon mat to remove the stain, and a fresh coating shall be reapplied.

3-33. After controlling the stain formation, discontinue agitation, apply additional solution to keep all surfaces wet and observe the aluminum surface for a color change. The aluminum will turn a brassy, yellow and/or iridescent greenish tint, which is easily detected through the overlying solution.

3-34. Do not let the coating over develop; surface powdering will be experienced. Disturb such areas by rubbing with fingers (gloves on) or non-abrasive nylon mat as necessary.

3-35. When a take of the coating shows on all areas, stop the reaction by rinsing or flooding the area with fresh clean water. The reaction of the solution is stopped by diluting the acid component. Be careful not to flush the solution into areas where it cannot be removed and/or further diluted by water. Accidental spills in confined areas can be neutralized using baking soda followed by rinsing with clean water.

3-36. Allow the surface to drain and/or pick-up the excess water by absorbing in a sponge by blotting action; do not rub. Excess rubbing will remove the coating since it is soft.

3-37. Areas not properly coated (including those that are powdery) shall be recoated by reapplying fresh coating solution, abrading lightly with a nylon mat (nonabrasive or fine abrasive), allowing normal time for coating to develop, rinsing, and drying.

3-38. The coating should be allowed to air dry for 2 hours minimum or, if required, speed dried by blowing dry with warm clean air (140°F maximum) for 1 hour prior to using part or overcoating with paint.

### NOTE

- Check with Bioenvironmental Engineer and Environmental Management for proper disposal of excessive solution.
- The final protective paint system or primer shall be applied only on a completely dry surface and shall be applied within 48 hours after application of the MIL-C-81706 conversion coating. The reapplication of MIL-C-38334 corrosion removal compound and MIL-C-81706 chromate conversion coating will be reaccomplished if more than 48 hours have elapsed since the previous application.

**3-39. CORROSION REMOVAL SOLUTION/MAGNESIUM.**

3-40. The following acid pickle solution shall be used to remove surface oxidation and light corrosion from magnesium surfaces prior to surface treatment and painting. The container used to mix the solution shall be lead lined steel, stainless steel, or 1100 aluminum.

**Solution Composition**

Chromium Trioxide	24 oz.
Water to Make	1 gal.

**NOTE**

Excessive amounts of anions, such as chlorides, sulfates, and fluorides must not be allowed to build up in the solution as these anions tend to coat or etch the metal rather than clean or remove corrosion products from the surface.

■ 3-41. Deleted.

**3-42. SURFACE TREATMENT PROCESS FOR MAGNESIUM.****WARNING**

Chromic acid solution is highly toxic to the skin, eyes, and respiratory tract. Avoid all contact. Skin and eye protection and vapor control are required. Assure this operation has been reviewed by local Bioenvironmental Engineer.

3-43. Chemical pretreatment solution provides a passive surface layer with an inhibitive characteristic that resist corrosive attack and also provides a band for subsequent coatings. The solution consists of the following materials and must be mixed in the ratio specified:

**Chromic Acid Solution (Also known as Dow 19)**

Chromium Trioxide (O-C-303, Type III) (99.5% pure)	1 1/3 oz.
Calcium Sulfate (Ca So .2H O)	1 oz.
Water to Make	1 gal.
Operating Temperature to 90°F	70°F

**Container**

Stainless steel, aluminum, vinyl polyurethane or rubber

3-44. Add chemicals to the water in the order shown, stirring the solution vigorously, either mechanically or by air agitation for at least 15 minutes.

**WARNING**

Rubber gloves, acid apron, and eye protection shall be worn by personnel during all mixing operations.

3-45. Apply the solution to a properly prepared surface using a brush, clean rag, sponge, applicator bottle and/or a low pressure stream (flow-on, do not atomize). When applying solution to large areas start at the lowest surface working upward; applying the solution with a circular motion to disturb the surface film and assure proper coverage. Agitation shall be accomplished using a non-metallic acid resistant brush or aluminum oxide abrasive nylon mat (MIL-A 9962, Type I, Grade A). Solution works best when applied at 70°F or above; leave solution on the surface one to 20 minutes; until a dark brown coating is produced. Rinse with cold running water while insuring complete flushing of any residual materials.

**3-46. SOLVENT WIPE, AIRCRAFT PREPAINT.****WARNING**

Provide adequate ventilation when using 50/50 mixture of MEK and Toluene. Avoid prolonged breathing of vapors and avoid skin contact. Use appropriate protective gloves and eye protection. Contact Bioenvironmental Engineering to determine need for respiratory protection.

3-47. Due to the necessity for having an exceptionally clean surface to receive the new paint system, a solvent wipe may be necessary if the surface becomes contaminated after chemical treatment. Given this requirement, each time the coating sequence of an aircraft is broken and the surface has been vulnerable to the accumulation of soils such as dust, shop dirt, fingerprints, overspray, leaks, etc., either after conversion coating application, priming, or between topcoats, a hand solvent wipe shall be performed. This will be accomplished immediately prior to application of further paint

coats to assure cleanliness and the adhesion of the paint film to the surface. The hand solvent wipe down shall be accomplished using MIL-T-81722, Type II, Thinner. The solvent will be applied and the surface wiped using wiping cloths. Wiping cloths shall be 100 percent cotton which are unbleached and have not been exposed to other chemical solution. When accomplishing the solvent wipe, always pour fresh solvent on to the cloth and dispose of them as they accumulate soils. The solvent wipe must be performed in this manner in order to prevent simply smearing soils or transferring them back to the surface from a pail of contaminated solvent. This operation must be accomplished when required and always just prior to application of the primer or subsequent paint topcoats.

**WARNING**

These solvents should not be used on polycarbonates or acrylics. These solvents will cause most rubber products to swell; however, the rubber will return to its original shape when the solvent evaporates.

3-47A. Solvent Wipe, Aircraft Prepaint for Environmental Compliance. In addition to the solvent wipe addressed in the preceding paragraph, the Ozone-Depleting Compound-Free Solvent Wipe (DS-104 and DS-108) have been screened and are approved for use on weapon systems. The hand-solvent wipe shall be accomplished using DS-104 for cleaning hydrocarbon soils and D-108 for cleaning uncured resins, inks, and dyes. Both solvents evaporate slower than MIL-T-81722, Type II Thinner. When using these solvents, use only a small amount of solvent on a wiping cloth; do not saturate the cloth. Wipe the surface being cleaned and then wipe with a dry wiping cloth. When the cloth becomes soiled, dispose of it in a closed container. This operation must be accomplished when the surface to be painted has become contaminated and always just prior to application of primers or subsequent topcoats.

**NOTE**

These solvents are available under NSN 7930-01-367-0985 for 55 gallons of DS-104, NSN 7930-01-367-0986 for 5 gallons of DS-104, NSN 7930-01-367-0997 for 55 gallons of DS-108, and NSN 7930-01-367-0996 for 5 gallons of DS-104.

### 3-48. PAINT SYSTEMS FOR SPECIFIC EQUIPMENT.

3-49. Refer to TO 1-1-4 and -23 TO's for aircraft, TO 35-1-3 for support equipment, or specific repair TO's for determining the proper paint system to be used.

### 3-50. MASKING.

3-51. Masking off areas is almost invariably required in painting operations on large assemblies or structures either for protective reasons, as in the precautionary note below, or for purposes of delineation. In spray application of coatings, masking operations may consume more man-hours than the actual painting.

**NOTE**

To prevent overspray and/or paint drift of one color or material onto another, untreated kraft paper may be used to mask/cover areas not specifically described below where protection of an area against overspray is the prime consideration.

a. Mask areas such as windows, canopies and large openings with combinations of barrier materials:

- (1) Specification MIL-B-121, usually a treated paper which is oil and moisture resistant.
- (2) Specification MIL-B-131, usually a laminated foil and cloth or foil and paper with good water vapor resistance.

**NOTE**

Both types above are heat sealable.

(3) Pressure-sensitive masking tape conforming to MIL-T-21595, Types I, II, and III.

b. Cover small or irregular shaped parts with tape alone.

c. In repetitive spraying of the same or similar structures it is advisable to have available predesigned bandages, socks, etc., of barrier paper or cloth. Locally-manufactured foam plugs/inserts may be used to protect aircraft inlet areas (e.g., scoops, air intakes, engine intakes, etc.) from painting as a replacement for masking and barrier paper. It is recommended that MIL-P-26514, cushion material, be used in the making of foam plugs/inserts. One side of the plug should be covered in replaceable plastic or barrier material for easy cleanup.



**NOTE**

Care should be taken to ensure that paint is not applied to certain surfaces where paint will interfere with a function. The following should be masked or otherwise protected during painting: Machined surfaces that move with respect each other such as threads, bearing contacts and gear teeth; electrical parts, such as contacts, relays, insulators, sockets, plugs, connectors, wiring and terminals; plastic and rubber (natural and synthetic) mounts, spacers, etc., and lubrication fittings, cups, oil holes, etc.

d. Avoid using tape in such a way as to leave a paint edge on aerodynamic surface unless feathering by sanding can safely be done.

e. Use only approved masking tapes in varying widths required by the job. A complex or

curved area is better masked initially at the paint edges with narrow (1/2 inch) tape. Wider tape may then be applied over the narrow, if required.

f. Use only approved marking paper for large area marking. Coating solvents may dissolve and deposit printing ink from newspapers, etc., on surface of the area being masked.

g. When spray painting, mask or cover surfaces at a distance from the area being painted which might receive overspray or paint drift.

h. Masking tapes should be removed as soon as possible after coating application to allow edges of coating to heal and draw down as much as possible.

i. Press tape firmly when applying it to prevent paint bleeding under it by capillary action.

**WARNING**

Exercise extreme caution in applying protective finishes to parts and equipment which may contact propellants whether directly or by accidental spillage. Critical areas may have to be masked. The guidance of applicable equipment technical manuals or engineering drawings shall follow concerning use of protective finishes on parts or equipment for use in or near propellant storage and transfer systems.

j. Pressure-sensitive masking tape conforming to MIL-T-21595, Types I, II, and III will be used for masking the aircraft prior to paint application.

### 3-52. TACK RAGGING.

3-53. To ensure that all primed surfaces are free from foreign matter, they should be tack-ragged immediately before applying the topcoat. Do not tack-rag an entire large structure at one time. Each area to be painted should be tack-ragged immediately prior to the application of finishing material to that area. Surfaces are gently wiped with the tack-rag, removing accumulations of dust and other foreign matter. One form of tack rag in common use is an unused cotton cloth conforming to DDD-R-30 dampened with MIL-T-81722. Other commercially available forms of tack rag which are designed for the purpose of removing surface contamination from an area receiving paint may also be used. Do not use a tack-rag to clean more than 10 square feet at a time to prevent spreading any contaminants on the rag over a large surface. Commercial rental wiping cloths or laundered shop cloths or disposable fiber or chemically treated paper wiping materials shall not be used.

### 3-54. SPRAY BOOTHS AND PAINTING AREAS, GENERAL.

3-55. Spray painting will be conducted in properly ventilated spray areas. A spray booth is an enclosure which confines and exhaust fumes and overspray during painting operation. Air flow design will be such as to provide adequate velocity at the face of the booth. Basic airflow criteria for specific type paint booth is available from the Bioenvironmental Engineer. (Also, see TO 42A-1-1, AFOSH STD 127-66.) Doors and windows which affect the area should be kept closed to exclude dust and dirt. The air should enter a booth at a rate which will not cause turbulence or excessive air currents but be sufficient to keep dried overspray from settling on surfaces which have been painted and are still tacky. A water-washed exhaust system or gridded

flooring or over flowing water should be used where practicable. Humidity and temperature indicators should be installed and kept in proper operation so that the temperature and humidity for correct spraying can be checked. Lighting conditions should be such that all surfaces to be painted are amply illuminated and artificial lighting and connecting electrical switching shall be explosion proof. Spray room surfaces should be cleaned as frequently as required to ensure good housekeeping.

**CAUTION**

Prior to spraying of paint, all safety regulations with regard to electrical grounding, fire prevention, vapor and explosion-proof lights, etc., must be rigidly complied with.

3-56. Two types of paint spray booths are in general use, the dry type and the air-water wash type. Traditional spray booths are generally effective at removing particulate matter such as solid particles of overspray, however they do not remove solvent vapors from exhaust air. Removal of solvent vapors for air quality emissions compliance requires supplemental processing equipment to collect the organic vapors on activated charcoal filters or to destroy the vapors by combustion or catalytic reaction. These special process capabilities are matters to be addressed by local civil engineering and environmental planning functions.

3-57. DRY-TYPE BOOTH. In a dry-type spray booth contaminated air is drawn through a series of baffles or filters before being exhausted to the outside. Dry booths are best suited for spraying lacquers and other quick-drying materials. Care should be taken to minimize air currents in the spray booth without interfering with removal of spray dust or with the health and comfort of personnel. Similarly, the sprayed articles should be removed from the region of strong air currents in the spray booth as soon as possible. When this is not practical, as in the case of large articles, the exhaust fan in the booth can be operated with a trip switch to enable the operator to stop the fan as soon as the spraying has been completed and the vapors have been removed.

3-58. AIR-WATER WASH TYPE BOOTH. In addition to the baffles used in the dry-type booth, a series of water curtains are used to trap and remove overspray solids from contaminated air before it is exhausted. An air-water wash type booth will remove over 95 percent of paint residue before it is exhausted, making it the ideal type for use in areas where clean exhaust air is necessary. Fire hazards are greatly reduced when the air-water wash booth

is used. A deflocculating material called water wash compound is added to the water to prevent overspray from adhering to the working portion of the booth. Water wash compound also serves to prevent rusting. A paint sludge removal system may be installed in these booths to decrease the frequency of changing the water. These systems are listed in the corrosion Table of Allowance (TA-480) under paint booth separator.

3-59. **CLEANING AND MAINTENANCE.** A suitable booth coating should be applied to all dry interior surfaces of the booth to facilitate cleaning. Paint residue which floats on the surface of the water should be removed each day to prevent it from settling to the bottom of the tank. Spray booths should be coated with approved fireproof material. The applicable equipment documents should be consulted for complete information on paint spray booths. It is of considerable importance to keep the spray booth and its immediate vicinity as free from dirt and dust as possible. The strong draft created by the exhaust fan pulls dust from outside into the booth and may deposit it on the sprayed surface. General cleanliness is therefore of considerable importance in spray finishing.

#### NOTE

Painting of entire aircraft will necessarily be accomplished in a variety of locations including interior areas not primarily designed for painting operations and out-of-doors. Insofar as applicable, all safety precautions and directions on environmental and materials controls pertain in these areas also. Painting in maintenance hangars shall be restricted to the minimum necessary to maintain the integrity of the coating system and shall always be under cognizance of local safety, fire and medical service representatives. Painting in maintenance hangar will be done IAW TO 42A-1-1, Section III.

#### 3-60. SPRAYING SYSTEMS, GENERAL.

#### NOTE

This manual provides only general information for spraying systems. See specific manuals or manufacturer's booklet for detailed operating and maintenance instructions. See Federal Supply Catalogs for proper Federal Stock Numbers (FSN's) and the current Master Cross Reference List (MCRL) C-RI-1-AF to convert specification and part numbers to Federal

Stock Numbers. EAID authorization for equipment type items must be established in accordance with Part I, Volume IV, AFM 67-1.

3-61. The conventional spray systems have basic similarities necessary to their efficient operation. There must be an adequate source of compressed air, a supply of the finishing material from a reservoir or feed tank, and a spray gun, a device for controlling the combination of air and finishing material ejected in an atomized cloud or spray against the surface to be coated. Other refinements, such as an air-pressure transformer, air filter, water drain, hose cleaner, etc., are incorporated in the system to provide more efficient and satisfactory results. Figures 3-1 and 3-2 are diagrams of complete spray systems.

#### 3-62. AIR COMPRESSORS.

3-63. Air compressors are designed to provide a continuous supply of compressed air at a predetermined maximum pressure and a minimum volume in cubic feet per minute. There are two general types of air compressors, single stage and two stage. These can be further subdivided into many types such as portable or stationary, electric motor or gas engine driven, unloader or pressure switch controlled, and air or water cooler compressor.

#### 3-64. AIR REGULATORS (OR TRANSFORMERS).

3-65. A regulator is a device which regulates the air, indicates by gages, the main line and regulated pressure, and provides outlets to which spray guns and other air operated equipment may be connected. It should be capable of passing 15 cfm of air at 80 psi supply line pressure with a maximum of 10 pounds pressure drop.

#### 3-66. AIR CONDENSERS.

3-67. An air condenser is similar to the air transformer in that it separates oil and moisture from the air. A condenser is usually equipped with pressure gages but may be found without gages where a regulated supply of air is available.

#### NOTE

Air condensers and transformers should be drained at least once each day and more frequently in humid weather.

#### 3-68. AIR SUPPLY.

3-69. Figure 3-3 illustrates proper installation of an air supply for paint spraying.

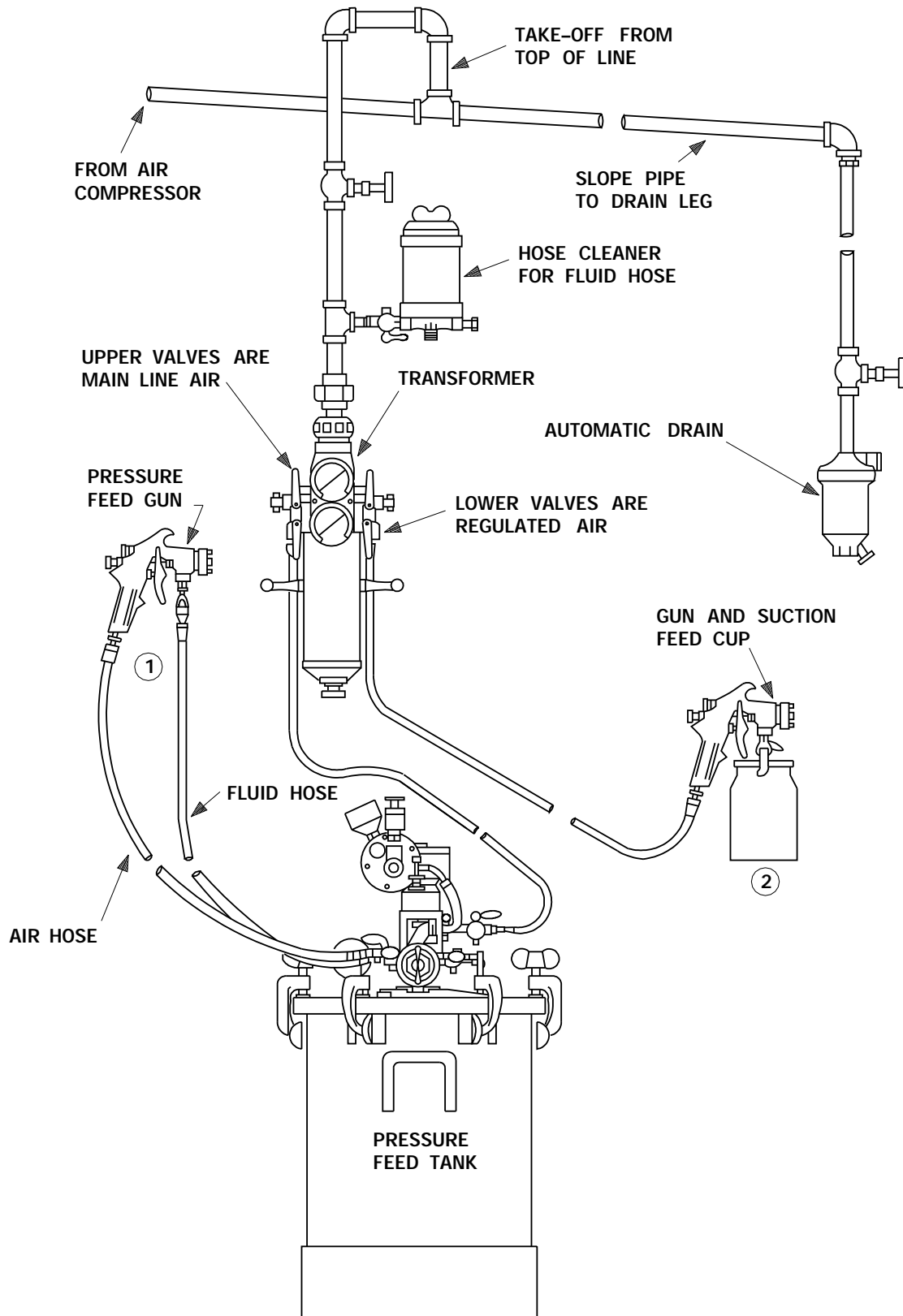


Figure 3-1. Complete Spray System

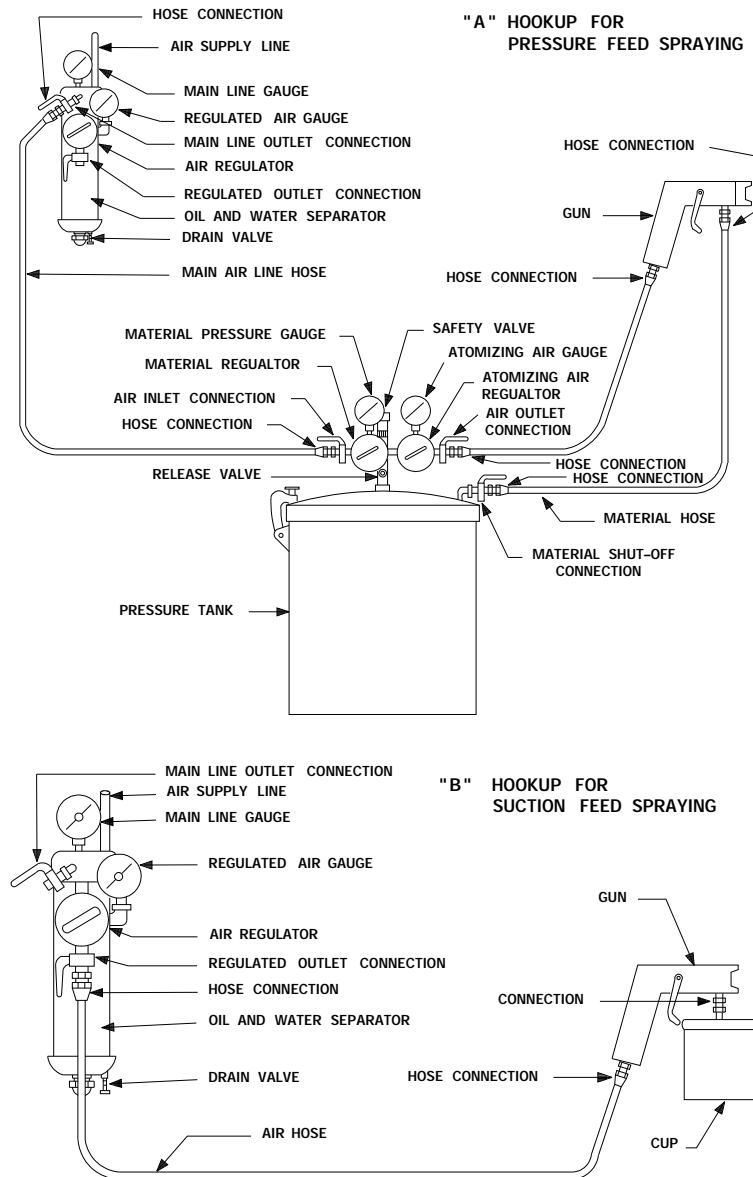


Figure 3-2. Simple Spray System Setup

### 3-70. HOSE.

3-71. Because of friction losses in hose it is essential that the proper sizes be used. Do not use hoses longer than 50 feet except in the case of high pressure air hose leading to the regulator or tank. These may be a maximum of 150 feet for the painting of the tail surfaces of exceptionally large aircraft which are a considerable height above the ground. Extra lengths of hose may be attached for this use but should be removed when no longer needed. The high-pressure air hose should have a minimum inside diameter of 7/16 inch. No less than 3/8 inch ID fluid

hose should be used from the tank to the gun and no less than 5/16 ID air hose from the regulator to the tank and from the tank to the gun. Any reduction in size or increase in length from the foregoing may produce unsatisfactory results. Air and paint hoses are furnished in various standard lengths. Determine the length required for use in a spray booth measuring the width of the booth and adding two feet for total length of the hose. When the hose is obtained in made-up lengths, the next length above these requirements is the one to choose.

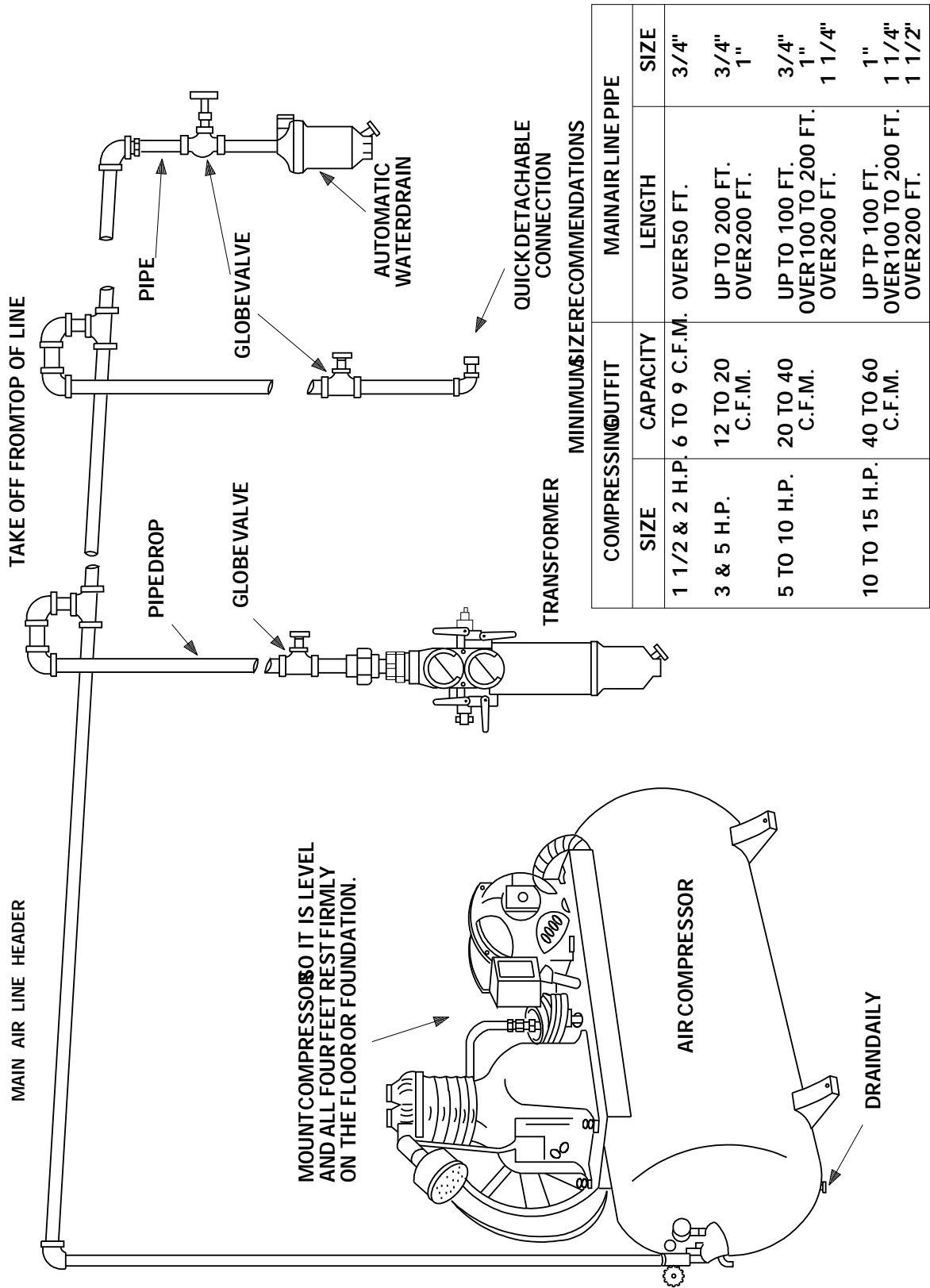


Figure 3-3. Proper Installation of Air Compressor, Piping

**CAUTION**

Hoses should always be thoroughly cleaned by flushing with solvent appropriate to the coating material used. When the material is a catalyzed system (epoxy or polyurethane), this must be done immediately after use to prevent the material from curing in the hose.

## 3-72. MATERIAL CONTAINERS.

3-73. Two types of containers serve as material supply reservoirs for spray guns, the cup and tank. Cup containers are used when small quantities of paint are to be sprayed. They will generally be of the suction type with a small vent on top of the container through which atmospheric pressure operates to force material up to the fluid tip when compressed air current creates a vacuum at the spray opening. Use pressure feed tanks for volume painting. Pressure feed tanks are tightly closed metal containers of varying size (from 2 to 120 gallons) that provide material at uniform pressure and a constant rate of flow. Compressed air is directed into the tank to force the material out. Air pressure must be increased or decreased to change the rate of flow. Both cups and tanks are available with agitators, in which case the material can be easily mixed and kept in suspension during application. The agitators may be mechanically operated or powered by an air/electrical motor. The primary use of these agitators is to provide continuous agitation required during application of many coatings. See Section IV for which coatings require this type of equipment.

## 3-74. SPRAY GUN, GENERAL.

**NOTE**

This manual provides only general information for spray guns. See specific manuals or manufacturer's booklet for detailed operating and maintenance instructions. See Federal Supply Catalogs for proper Federal Stock Numbers (FSN's) and the current Master Cross Reference List (MCRL) C-RI-1-AF to convert specification and part numbers to Federal Stock Numbers. EAID authorizations for equipment type items must be established in accordance with Part I, Volume IV, AFM 67-1.

3-75. The spray gun is a mechanical device for atomizing or breaking up coating material into a spray and applying it, under control, as a film to a surface. Figure 3-4 illustrates in sectional view a

conventional type spray gun used by the Air Force. It is a precision instrument and must be treated as such. Its care and daily maintenance determine the effectiveness of spray painting. It should not be used by untrained personnel.

3-76. CLEANING AND MAINTENANCE OF PAINT SPRAY GUNS. Proper maintenance of the spraygun is necessary in order to preserve the life of the gun and ensure high quality results. The gun requires little maintenance if kept clean.

a. Maintenance. Spraygun maintenance consists of occasional lubrication. The packing that surrounds the air valve stem should receive a few drops of light oil in order to maintain easy movement of the air valve. The packing enclosed in the packing nut around the fluid needle should be lubricated for easy movement of the fluid needle assembly. The spring for the fluid needle assembly should be coated with petroleum. In addition to lubrication, parts that show wear, such as air nozzles, fluid nozzles, and needle assembly, should be periodically replaced.

**NOTE**

Excessive tightening of packing nut will damage packing and needle valve assembly.

b. Cleaning. After each paint job the gun should be thoroughly cleaned. If cleaning is delayed the time needed to clean the gun is greater and there is a potential for damage to the equipment.

**WARNING**

When using solvents observe these cautions. Keep away from heat and open flame. Keep container closed. Use only with adequate ventilation. Avoid prolonged or repeated contact with skin. Avoid swallowing.

(1) The siphon-feed gun can be cleaned by unscrewing the air cap and releasing the cup from around the siphon tube at least a distance of 1 or 2 inches. Hold a cloth over the air cap and trigger the gun. Air will be sent into the passageways, forcing any excess paint back into the loosened paint container.

(2) Remove the paint container and clean the inside using thinner.

**NOTE**

Abrasive materials and chemical strippers should not be used to clean spraygun parts, as damage to the gun will result.

(3) Fill a quarter of the clean container with the correct thinner or solvent.

(4) Remove the air nozzle and carefully lower it into the cup of thinner.

(5) Using a nonmetallic bristle brush, clean the fluid nozzle openings and other parts of the gun that are difficult to reach, such as around the packing nuts and controls.

### CAUTION

Do not submerge the gun in thinner. Thinner will dry out the packings around the fluid and air stems.

(6) Dampen a rag with thinner and wipe the entire gun and cup until they are free of paint.

(7) Using the bristle brush, clean the air nozzle and its openings.

(8) Put the gun back together, and spray clean thinner through the gun until a fan of clear thinner is produced.

(9) Remove any excessive thinner, and wipe the cup and gun with a clean dry rag.

### NOTE

A spray gun is a piece of equipment which contains parts that must work together. The dismantling of the spraygun after each paint operation will cause excessive damage to the gun and its seals. The spray gun should only be dismantled when a proper spray pattern cannot be produced.

3-76A. Mechanical Paint Gun Washer. The most effective method for cleaning paint spray guns, paint fluid hoses, and paint pots/cups is by using a mechanical paint gun washer. These washers use either MIL-T-81772, Type II, Thinner or low vapor pressure solvents. The solvents are contained in a closed-loop system, consisting of a cover, pneumatic pump, spray nozzles, filtration system, and pneumatic controls. The inside of the container shall have devices installed for connecting paint guns for internal as well as external surfaces. The use of these washers reduces hazardous waste, volatile organic compound emissions, solvents required to manually clean the paint equipment, and hazards to the personnel. Solvent replacement shall be done in accordance with manufacturer's instructions.

### 3-77. CLASSES OF SPRAY GUNS.

3-78. Spray guns are classed in two general types as suction feed and pressure feed, either type further subdivided as to having external or internal mix air caps.

a. The suction feed (or siphon) gun is usually fitted with a fluid cup, and its nozzle assembly is designed to feed paint into the air-stream through vacuum created by the protrusion of the fluid tip beyond the air cap. The amount of spraying at one time is limited to the contents of the cup. This gun is most conveniently used in painting smaller areas, usually within the confines of a spray booth. (Detail B, Figure 3-2 illustrates suction feed hook-up.)

b. The pressure feed guns operate with the fluid being supplied under pressure to the gun from an external tank through a hose. The air cap and fluid tip are flush with each other and no siphoning effect is necessary. It is the tool for volume painting. (Detail A, Figure 3-2 illustrates pressure feed hook-up.)

3-79. The mechanism of pressure and suction feed guns are the same, and both types can use internal or external mixing of the fluid and air. Most conventional spray guns used in the Air Force are of the external mix type.

### 3-80. APPLICATION OF COATINGS, GENERAL TECHNIQUES.

3-81. GENERAL. The following paragraphs deal with application methods, techniques, problems and remedies of coating application, aircraft paint procedures, and specific application requirements for the predominant coating systems used by the Air Force. Except when otherwise directed by this technical manual or by local requirements or limitations, protective organic coatings may be applied by spraying, brushing, or any other approved method which will result in continuous adherent films. The method selected or directed for use in applying coatings to aerodynamic surfaces shall be developed and adjusted in all respects to provide film integrity, optimum adherence, smoothness and good appearance. To achieve acceptable finishes on airframe surfaces requires the use of trained personnel plus certain disciplines of operation. Pre-planning for painting is an absolute requirement in order to provide a schedule or operations, to arrange for a cleared working area, to have available painting aids such as scaffolding and cleanup materials and equipment, etc. Correctly preparing coating materials and maintaining painting equipment in good operating condition are as important as knowing the techniques of applying coatings.



**NOTE**

Precautionary measures shall be taken to prevent paint and paint removal waste from contaminating lakes and streams. Some of the chemicals utilized for painting and paint removal require treatment or other special control prior to disposal. Disposal of materials shall be accomplished under the direction of the

Base Civil Engineer, Safety Office, Bioenvironmental Engineer, and Environmental Management in accordance with applicable directives and in a manner that will not result in violation of local, state, or federal pollution criteria. Detailed information for disposal is cited in AFM 85-14, AFM 85-11, AFR 91-9, AFR 91-9/AFLC Sup 1, and AFR 19-1.

### 3-82. SAFETY AND HEALTH ASPECTS OF PAINTING.

3-83. Painting operations present hazards which require control or preventive measures. Vapors produced, particularly in spray painting, are usually highly flammable, as are the accumulated dried coating materials deposited on walls, floors, and equipment in painting area. Also, coating materials and their thinners very often contain toxic substances which are injurious to health by inhalation and, to a lesser degree, by physical contact. Painting operations also involve hazards of physical injury in the

improper use of work stands, ladders, hoists, etc. Under supervision of the local Safety Engineer and the Bioenvironmental Engineer, all painting personnel shall take all requisite safety precautions with regard to toxicity, other health, and flammability hazards in accordance with existing instructions and regulations. AFOSH STD 127-66, and TO 42A-1-1 are applicable and, within the purview of this technical manual, all safety precautions within these manuals regarding personnel health, fire prevention, ventilation, handling of equipment, electrical grounding, storage of coating materials, area preparation, use

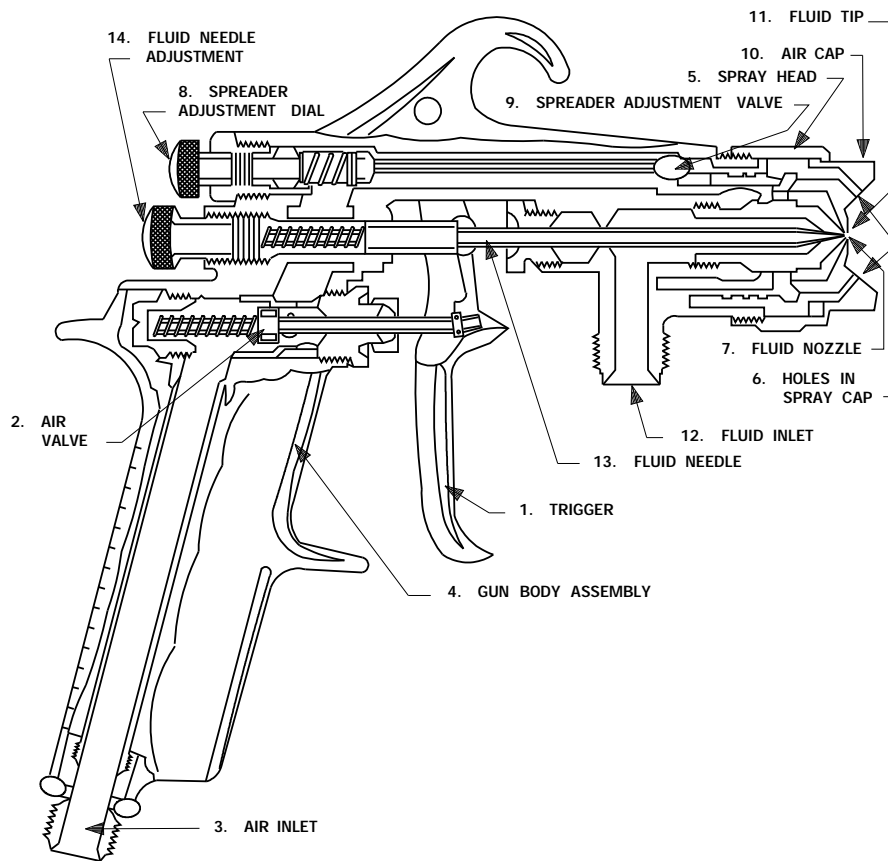


Figure 3-4. Sectional View of Spray Gun

of vapor-proof lights, etc., are mandatory. The following measures are minimum requirements for personal safety:

a. Wear approved respiratory protective devices.

b. Wear protective clothing to prevent contaminations of ordinary clothing. Protective clothing should not be stored in the painting area but in ventilated metal lockers in some other convenient location.

c. Wash thoroughly after painting and before eating, and do not carry food into spraying areas.

d. Spray paint only when good local exhaust or general ventilation is available.

#### WARNING

Spray gun nozzles are sources of very high pressure. During operation/cleaning of paint sprayer, the hand will never be placed in front of the nozzle.

e. Spray painting equipment presents hazards of which paint operational should be aware. Consults manufacturers' brochures for proper handling, cleaning, operation and precautionary procedures.

### 3-84. APPLICATION METHODS, GENERAL.

3-85. Spray application is standard in the Air Force for aeronautical requirements and most other equipment. It is rapid and in the hands of skilled operators produces films of good uniformity and quality. When application of coating is described in this technical manual without specifying the method, conventional cold spray application is implied. Methods other than spraying are of use in special cases, particularly in non-aeronautical or less critical applications. Brush or roller applications have their place and should be considered as alternate measures with suitable materials when the volume of the work to be done does not justify the setting up of spraying equipment, when spray equipment is not immediately available or is inaccessible to the job, when the masking required by spraying would be excessive, and when the cold spray method may result in damage to nearby equipment or constitutes a health or fire hazard. In addition, some circumstances demand brush application, such as porous surfaces which require brushing in for adequate coverage and penetration.

### 3-86. SPRAY METHODS.

3-87. The Air Force uses several hand-operated spray methods: The conventional air atomization method, the hot spray, and the cold airless and hot airless methods. The first method is still most commonly used in the Air Force with the hot airless methods coming into greater use with the introduction of improved airless equipment.

#### NOTE

Aerosol spraying is limited in application and should be held to a minimum. It is permitted for touch-up of scratches, etc., and areas not exceeding one-half square foot in area. The tendency toward use of aerosols as a convenience is considered poor painting technique.

3-88. CONVENTIONAL SPRAYING. In this method the coating material, generally thinned from the package viscosity, is atomized by striking it with a high speed jet or jets of compressed air and is directed as a mist by the spray gun nozzle to the work. A very large volume of air in comparison to the volume of the paint is required at high speed to properly atomized and convey a viscous coating materials. The more viscous the material the higher the energy required. Reduction of viscosity by thinning is customary in order to reduce air

requirements. Only a small amount of the energy released by a spray gun is used for atomization; the rest moves surrounding air and delivers the material. Additionally, the expending of a large amount of compressed air causes a refrigerating effect on the paint being sprayed. Cooling of the paint below ambient air temperature can cause moisture condensation and increase the potential for paint blushing. In conventional spraying, the stream emerging from a spray gun is a high speed air current of which less than one percent is coating material. Most of the force of the conveying air is expended against the work and, in rebounding from it, much of the coating material is blown away from or beyond the target. The material lost is the price paid for efficiency in other respects. As this overspray may account for 50 percent of total material, good application techniques should always be used to keep it at the minimum, consistent with effective coating.

3-88A. TOUCH-UP SPRAY GUN. For minor touch-up and application of insignias/markings, a small conventional spray gun may be used. This gun operates similar to the conventional spray gun identified in paragraph 3-88. This spray gun has a small cup (less than a quart) and may be used as a replacement for the Power Pak Spray unit when an air source is available.

3-89. HOT SPRAYING. Hot spraying is the application of coatings with conventional spraying equipment, using heat as a substitute for all or a portion of the thinner ordinarily used to reduce coating-materials to spraying viscosity. Heat is most frequently used in the so-called airless spray system, but it is also used in conjunction with conventional air spraying. Preheating coating materials reduces some of the limitations of the conventional method in the smaller amount of thinner required, in the number of topcoats required, and in the heavier coat which can be applied in one pass. Also, the hot paint, while cooled rapidly when atomized, retains sufficient heat to still be close to the ambient air temperature when it reaches the work surface. The possibility of blushing due to moisture condensation is thereby reduced and spraying can be done under conditions of relatively high humidity which would otherwise be prohibited.

3-90. AIRLESS SPRAY. The terms airless or hydraulic refer to the spray coating method in which the coating material, heated or unheated, is atomized by ejecting it from special spray nozzles by hydraulic pressure on the coating material itself. No air is used for atomizing, and the atomized coating material emerges from the gun nozzle. The droplets move toward the work by their momentum and are appreciably slowed down by air resistance. There is less bounce of the material on arrival at the

work and less overspray. The refrigerating effect of expending air associated with conventional spray is not present. The only heat loss in the cold airless method is through solvent evaporation. In the hot airless method the material arrives at the work warmer than with other methods of spraying, usually at or above ambient temperatures.

**3-91. AIR-ASSISTED AIRLESS SPRAY.** In this method the coating material is atomized by hydraulic pressure the same as airless spray. The difference being that a much lower hydraulic pressure is used to atomize the coating material and low air pressure is directed at the paint mist. When atomizing the coating at low hydraulic pressure through the spray nozzle, proper spray pattern formation can not be achieved. The addition of low pressure air jets on the atomized coating provides even dispersement of the paint in a properly formed pattern. This method offers almost equivalent advantages in spraying as the airless spray method while being safer, due to the low hydraulic pressures used. Also, because of the low pressure, pumps on this equipment require much less maintenance.

**3-91A. HIGH VOLUME/LOW PRESSURE (HVLP) SPRAY.** In this method the coating material is atomized by a high volume of low pressure air through a spray gun. The difference is that much lower pressure between 0.1 and 10 psig is used to atomize the coating material, and a high volume of air is used to push, not propel, the material into a very soft, low-velocity pattern. This soft spray will generally provide a more consistent coverage and a better overall finish. Unlike the conventional air spray, the HVLP gun should be held closer to the surface because of the lower speed of the paint particles. The gun should be held at 6-8 inches from the workpiece. The film thickness is often greater than the conventional air spray systems. Also, because of the low pressure, the various types of equipment will require very little maintenance. This equipment shall not be used above 10 psig, otherwise the derived benefits of the HVLP will be negated.

**3-91B. HVLP TOUCH-UP SPRAY GUN.** For minor touch-up and application of insignias/markings a small HVLP spray gun may be used. This gun operates similar to the HVLP spray gun identified in paragraph 3-91A. This spray gun has a small cup (less than a quart) and may be used as a replacement for the Power Pak Spray unit when an air source is available.

**3-92. ELECTROSTATIC AIRLESS SPRAY.** A variation of the airless spray method, known as electrostatic airless spraying, has been introduced

to the Air Force. The hydraulic pump action and atomizing process is similar to that described in paragraph 3-90.

**3-93.** The added feature of this technique/equipment, is the electrostatic charging (60,000 volts at about 200 microamps) of the paint material which is then attracted to the grounded workpiece (aircraft, etc.). The charging of the paint material can occur either internal to the gun or the most common method charges the atomized paint material via fine metal probe at the exit of the gun nozzle. The combination of low particle velocity induced by the airless aspect and the electrostatic attraction to the workpiece produces the most efficient hand-operated spray method. Electrostatic spray painting equipment can be powered by an external electrical source or a self-generating electrical source contained within the spray gun. Overspray is greatly reduced and hard-to-coat areas such as edges or geometric shapes are more effectively painted. It should be noted that the workpiece (aircraft, etc.) is not charged electrically, but is grounded as in normal painting practices. However, safety aspects, operational parameters, and equipment maintenance must be stringently adhered to as follows:

a. Aircraft to be electrostatically painted shall be defueled and purged. Exceptions: Aircraft fueled only with JP-5 and JP-8 are authorized to be painted with electrostatic airless spray equipment approved in TA 480 without being defueled and purged, providing fuel temperature remains below 100 degrees F. Electrostatic spray painting of JP-5 or JP-8 fueled aircraft can only be performed in designated paint hangars that are approved for this function by the local base Fire, Safety, Bioenvironmental and Environmental Management Offices. Additional precautions for paint fueled aircraft are listed in paragraph 3-120 and 3-121.

b. Electrostatic coating application equipment will be used only in paint hangars or other areas designated and approved by the local base Fire, Safety, Bioenvironmental, and Environmental Office.

c. The ventilation system is on and operating. The ventilation system must also provide sufficient exhaust to remove the solvent vapors generated by the process and from the aircraft surface. The ventilation shall be sufficient to limit vapor concentration to 500 part per million or 20 percent of the lower explosive limit (LEL), whichever is lower as required by TO 42A-1-1, Section III. Electrostatic painting equipment powered by an external electrical source requires an interlock system to ensure that equipment can only be operated

if the ventilation system is operational. An interlock system is not required for pneumatically operated equipment. However, the paint hangar facility shall be equipped with an audible alarm system which would be activated in the event of a ventilation system failure.

d. All painters using the electrostatic equipment will be trained in its use. Painters will also be trained on the hazards associated with electrostatic painting and the fire/safety problems associated with the process.

e. All safety features on the equipment are operational.

f. No unauthorized personnel are allowed in the paint hangar during electrostatic painting operations.

g. Any personnel involved in concurrent operation in the paint hangar, not associated with the electrostatic painting process will be briefed on the hazards of static on ungrounded objects and provided the appropriate safeguards.

h. All aircraft, the electrostatic equipment, work stands, solvent containers/buckets, people, and adjacent equipment will be grounded prior to using the electrostatic painting equipment.

i. Prior to cleaning electrostatic paint guns, the operators will insure that they and the gun are grounded, and that the equipment is de-energized.

j. The manufacturer's operational/safety procedural criteria is used as a supplement to the foregoing procedures.

k. All electrical equipment within the paint hangar facility must be approved for explosion-proof environments. The electrostatic painting equipment used for this process must have been tested and approved by a recognized laboratory for Class I, Division I, Groups C and D usage.

l. When painting aircraft fueled with JP-5, and JP-8, the paint hangar facility and aircraft shall be protected with both an overwing and underwing Aqueous Film Forming Foam (AFFF) suppression system. The AFFF system must be fully operational prior to the start of electrostatic painting. Facility fire suppression required for electrostatic painting of fueled aircraft is outlined in Military Handbook 1008B.

m. Supervisory personnel must ensure all fire/safety countermeasures have been implemented prior to the start of the painting operation.

n. Lower Explosive Limit (LEL) readings in the fuel vent area must be taken prior to the

painting of each aircraft. LEL readings must be maintained at or below 20 percent.

### CAUTION

Electrostatic spray painting of JP-8 fueled aircraft constitutes a significant hazard when the on-board fuel temperature exceeds 100 degrees F.

#### 3-94. RESPIRATORY SAFETY DEVICES.

3-95. Many toxic materials are found in spray painting shops which may impair the health of personnel if control measures are not provided. Harmful concentrations of these materials may be reduced to a safe level by an efficient mechanical exhaust system. In areas where the exhaust system is not adequate, contact Bioenvironmental Engineering for selection of proper respiratory protection. It should be understood that a respirator is not a substitute for exhaust system but is merely a supplement to existing ventilation methods (refer to TO 42A-1-1 and AFOSH STD 161-1). The following respirators are recommended for use where exhaust system is inadequate:

Manufacturer	P/N
3M	8709
Wilson	TC 23C54 or 122115
Confo II	448849 (Medium) or 466528 (Large)

### NOTE

This manual provides only general information for respiratory safety devices. See TO 42A-1-1 or manufacturer's booklet for detailed operating and maintenance instructions. See Federal Supply Catalogs for proper Federal Stock Numbers (FSN's) and the current Master Cross Reference List (MCRL) C-R1-1-AF to convert specification and part numbers to Federal Stock Numbers. EAID authorization for equipment type items must be established in accordance with Part I, Volume IV, AFM 67-1.

#### 3-96. MATERIAL REQUIREMENTS, GENERAL.

3-97. Materials used in coating operations on Air Force airframes and equipment should normally conform to Military or Federal Specifications and shall be applied as directed in this technical manual and other pertinent technical publications.

**NOTE**

Unauthorized material shall not be used by Air Force activities on airframes and associated equipment.

3-98. It is recognized that proprietary non-specification materials may exist on airframes and equipment as supplied by the manufacturer, and the maintenance of these may offer special difficulties. Logically and normally the repair maintenance of proprietary coatings should be with the same material. However, where it can be determined by the engineering function of the item or weapon manager or is cited in this technical manual that compatible materials are available, these may be used for touch-up purposes. In case of complete unit stripping and recoating, only Air Force authorized specification materials shall be used.

**NOTE**

To avoid the possibility of incompatibility in materials under the same specification but of different manufacture, such materials shall not be mixed. Primers of different manufacture but under the same specification are not to be mixed, but may be applied separately to areas which are to be overcoated. Every effort shall be made, however, to assure that an

entire topcoat is restricted to the product of a single manufacturer and, where possible, to the same batch in order to maintain uniformity of color, gloss, etc.

### 3-99. PREPARATION OF MATERIALS FOR USE, GENERAL.

<b>WARNING</b>
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Containers of paint may develop internal pressure during storage and should be opened with caution.

3-100. Finishing materials shall be prepared for application under clean conditions with clean equipment. Paint shops shall be equipped with mechanical paint agitators of suitable capacity. The proper sequence for preparing packaged materials prior to each use is as follows:

- a. Allow materials to come to room temperature.
- b. Remove lids and inspect paint skinover, gelling, lumps, etc. Skins, if present, shall be carefully removed and discarded, retaining liquids which drain from them. Gelled, lumpy or otherwise deteriorated paints shall not be used.

**NOTE**

Cans of pigmented paint with non-resealable lids should not be opened and inspected until after the original mechanical agitation.

c. Thoroughly agitate all pigmented paints, using a mechanical agitator prior to thinning and prior to and during application.

d. Thinning shall be controlled by weight, volume or viscosity measurement (paragraph 3-106) to obtain and maintain proper and uniform consistency. If there is no specification covering the material, thin according to manufacturer's instructions. Unless directed by system peculiar technical manuals, do not add thinners or solvents to high solids primers and topcoats. Reducing with thinners or solvents can cause high solids coatings to exceed the maximum volatile organic compound (VOC) content in areas where air pollution regulations are in effect.

**NOTE**

Do not mix materials of the same specification but supplied by different manufacturers. This will avoid problems of incompatibility in the liquid and drying phases.

e. Reduction and/or catalyzation of paint shall be in accordance with paragraph 3-101 and 3-111, or manufacturer's instructions. If this does not produce the proper spraying viscosity, quality control facilities shall be consulted.

f. Strain all material to be used in spray equipment through fine mesh metal strainers or cheese cloth.

### 3-101. MIXING AND THINNING OF COATING MATERIALS, GENERAL.

3-102. The mixing of coating materials may seem too elementary to require lengthy discussion; however, it is a very common source of trouble either through negligence or lack of knowledge. All coating materials require field preparation prior to application, and differences in color, gloss, hiding power, and film application characteristics can be expected if materials are not adequately prepared in this respect. Pigments, which give color and other desirable characteristics to coatings, are generally insoluble. Since most of them are heavier than the liquid portion of the coating material, they inevitably settle out of suspension. The consistency or viscosity of the liquid portion decides the rate of settling; for example, pigments mixed with a thinner alone would settle out in a few minutes but in a paint vehicle it might take months. One of the reasons coating materials are packed at as high

consistency as practicable is to slow the setting. The practice of thinning too much material at a time and pouring unused portions of the material back into the original container lowers the total consistency and increases the rate of settling. Settled material usually re-disperses readily unless it is over-aged or has become exposed to the atmosphere. In some materials, however, such as wash primers and some of the vinyl based materials, settling may be accompanied by some change in chemical structure after storage of only a few months. Such changes are not reversible; therefore, judgment should be employed whenever using them.

**NOTE**

Lacking directions to the contrary, coating materials in general should be viewed as having at least two years shelf life. After this age, scrutinize material before using it. If an aged material appears unsuitable by visual inspection after appropriate and extended attempts at mixing and reducing, it should be discarded. If the quantity involved is large, laboratory tests to determine its continued conformance to specification requirements will be required before either its use or its disposal.

### 3-103. METHOD OF MIXING.

**WARNING**

Mixing shall be done in areas that are well ventilated and away from any source of open flame and direct sunlight.

3-104. Following are methods of mixing in containers:

a. For hand mixing in cans and drums, follow manufacturer's instructions.

b. Mixing of materials in containers up to five gallons is best accomplished by using mechanical mixers of the type that vibrate or shake the unopened container.

3-105. A simple test of complete mixing is to flow samples down an inclined piece of glass. Irregularities of color or flow will indicate incomplete mixing. Comparison of materials from the bottom and the top of a container may be made by this method.

### 3-106. VISCOSITY.

3-107. In connection with organic coatings, viscosity may be defined as fluid's internal resistance to flow. A fluid of low viscosity flows freely or is thin; fluids of higher viscosity flow more slowly or are

thicker. Viscosity is significant in applying any coating but particularly so in spray application and most particularly so in cases of materials such as the catalytic coatings (epoxies and polyurethanes).



Within reasonable limits, viscosity, has little direct effect on film properties, since it is a measure of thinning by volatiles which ultimately leave the film, but correct viscosity control is essential to obtain consistent results in application. Too low a viscosity will lead to runs or sags or too-thinly applied coats and possibly to blushing. High viscosity may cause orange peel effects, excessive film thicknesses, or dusting. In prolonged coating operations viscosity must be controlled to duplicate results.

**3-108. VISCOSITY MEASUREMENTS.** Viscosity is measured by various methods and instruments and expressed in various units of measurement accordingly. The methods most frequently cited in the coating industry use either the Ford or the Zahn Viscometer Cups. In both methods, viscosity is expressed in seconds through the cup. The seconds indicate the length of time it takes at a given temperature for a known quantity of the coating material to flow through a certain size orifice in the cup. For example, viscosities (at 77°F) of 16 to 20 seconds through a No. 4 Ford Cup (or 19 to 27 seconds through a No. 2 Zahn Cup) are generally right for spraying enamels, and 12 to 18 seconds through a No. 4 Ford Cup (or 14 to 21 seconds through a No. 2 Zahn Cup) for lacquers. For comparison, the viscosity of lacquers may be as high as 200 seconds; for enamels, from 40 to 150 seconds. This range in viscosities results in corresponding differences in the amounts of thinners required to obtain painting viscosities.

#### NOTE

For the purpose of this technical manual, the Zahn method has been chosen as the standard most appropriate to field use.

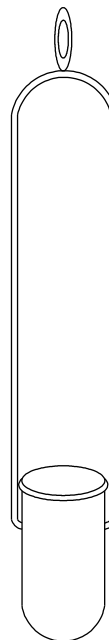


Figure 3-5. Zahn Cup

#### 3-109. ZAHN CUP.

**3-110.** The Zahn Cup is designed to measure the viscosity of fluids directly from their containers. It consists of a 44 mil cup with a hole orifice and wire handle (Figure 3-5). It is filled by immersion in the fluid, and the flow is timed from withdrawal to first interruption in the flow. Five graduated orifice sizes, or cup numbers, are available. The No. 2 cup is most suitable for aircraft painting requirements. Cups are available from McMaster-Carr Supply Co., Chicago IL, or Paul N. Garnder, Co. Lauderdale by the Sea FL.

#### 3-111. THINNING PROCEDURES.

**3-112.** When thinning is necessary always add thinner to the coating material. Adding coating material to thinner may result in an irreversible separation of some of the coating ingredients. It should be added slowly with continual stirring to obtain complete mixing. For all thinning use only thinners authorized in applicable instructions in this technical manual or pertinent specifications or, in the absence of these instructions, those recommended by the manufacturer. The wrong thinner may destroy certain characteristics of a coating material without immediately giving visual evidence in the wet state. Reduced material which has increased in viscosity due to evaporation will require corrective additions. However, some coating materials which undergo chemical processes such as polymerization to create a film cannot be thinned beyond a certain point and remain usable, nor can they be brought back to the

correct viscosity by thinning after the chemical action has progressed beyond a recommended point.

### 3-113. BLUSHING.

3-114. Blushing of coatings is the result of condensation of water from the atmosphere within or on a drying organic film. It occurs when the temperature of the work surface falls below the prevailing dew-point. (It shall always be looked for in production coating whenever other than average atmospheric conditions prevail.) It shows as a lighter-than-normal or whitish discoloration or increased opaqueness of film. It may occur to the extent that a surface powder results which can be removed by a fingernail or by light rubbing. (Rubbing will not cure the condition.) It may also be almost imperceptible, and blush-inducing conditions may escape notice on test panels sprayed prior to production coating due to their temperature difference from that of the projected job.

#### NOTE

Slight blushing may sometimes be detected by noting faint dissimilarities of appearance in the film occurring over structural members underlying

the surface as such as bulkheads, ribs, etc. There can be a temperature difference in skin surfaces in contact with internal structures, and this difference may be reflected and outlined in blushing.

3-115. Blushing most often occurs in the quick-drying coatings such as the lacquers and only rarely in enamels. It is detrimental in some degree to any coating material and will affect adhesion of superimposed coatings. Any blushed areas must be stripped and redone. Superficial blushing may occur at borderline temperature/humidity conditions and subsequently disappear. This is not considered harmful and may be ignored.

### 3-116. PREVENTING LACQUER BLUSH.

3-117. The remedy for blushing is either to stop application until better atmospheric conditions prevail, to change those conditions, or to use blush retardant thinners. For cold spraying of lacquer thinned only with Federal Specification TT-T-266 Thinner, blushing generally can be avoided by observing the following humidity schedule of permissible atmospheric conditions.

At Dry Bulb Temperature In Degrees Fahrenheit	Maximum Permissible Percent Relative Humidity
95	54
90	56
85	59
80	63
75	68
70	74
65	80
60	85

### 3-118. BLUSH RETARDANT THINNING.

#### WARNING

Ethylene glycol monobutyl ether is toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

3-119. Under conditions of high temperature (80°F to 95°F) and low relative humidity (less than 20 percent), dry spray may be encountered. Under these conditions, blush-retardant thinners should also be used. If blushing of lacquer topcoat is observed on the test panel; specified in paragraph 3-

131 blush-retardant thinner should be used. Two blush-retardant thinners are available, covered by Federal Specification TT-E-776 and Specification MIL-T-6095. The former is more effective but should be used with caution because of its slow release from the film. The use of blush retardant thinners is as follows:

a. For each gallon of Federal Specification TT-T-266 Thinner, replace up to 1 1/2 pints with ethylene glycol monobutyl ether conforming to Federal Specification TT-E-776. Only the minimum amount necessary to alleviate blushing should be used since sagging may result. Also, drying may be retarded as much as 10 minutes if ambient temperatures are low.

Dry Bulb Temperature In Degrees Fahrenheit	Percent Relative Humidity (Maximum)
95	57
90	60
80	69
75	75
70	81
65	87
60	90

b. For each gallon of Federal Specification TT-T266 Thinner replace up to a half-gallon with Specification MIL-T-6095 Thinner. If replacement of Federal Specification TT-T-266 Thinner with a greater amount of Specification MIL-T-6095 is required, the ratio should be determined on a small scale operation as described in paragraph 3-143. To avoid sagging take precautions against adding excessive amounts of Specification MIL-T-6095 Thinner.

c. The maximum relative humidity for cold spraying of lacquers thinned with blush-retarded thinners at the specified dry bulb temperatures is contained in the schedule listed above.

d. When humidity control is not available, the relative humidity may be lowered by raising the dry bulb temperature proportionately but not to exceed 90°F for normal operation unless Federal Specification TT-E-776 blush-retardant thinner is added.

#### NOTE

Enamel can be applied at higher relative humidities than lacquers without encountering blushing.

### 3-120. PAINTING OF AIRCRAFT, DEPOT LEVEL OPERATIONS.

3-121. Painting of fueled aircraft must be approved by the MAJCOM Fire Protection Engineering Office. Painting of fueled aircraft is authorized if and only if the following precautions are followed. Additional considerations for electrostatic spray painting of fueled aircraft are covered in paragraphs 3-92 and 3-93.

#### CAUTION

Electrostatic spray painting of JP-8 fueled aircraft constitutes a significant hazard when the on-board fuel temperature exceeds 100 degrees F.

a. Base Fire, Safety, Bioenvironmental, and Environmental Management Offices shall approve

locations for spray painting aircraft. Aircraft containing JP-5, JP-8 or equivalent fuel may be electrostatically painted at depot level operations, providing the on-board fuel temperature is below the flash point of 100 degrees F before electrostatic painting operations begin. The aircraft being electrostatically painted must be grounded in two locations to prevent accidental electrical discharge from the electrostatic spray equipment. Each base is responsible for establishing procedures to ensure that the temperature of on-board fuel is below 100 degrees F before and during electrostatic painting applications.

b. The ventilation system must provide sufficient exhaust to remove the solvent vapors generated by the process and from the aircraft surface. The exhaust stream should be maintained below 25 percent of the Lower Flammability Limit (LEL) with no more than 500 ppm total solvent vapor concentration. The paint hangar facility shall be equipped with an audible alarm system which would be activated in the event of a ventilation system failure. In areas where the exhaust system is not adequate, contact Bioenvironmental Engineering for selection of proper respiratory protection.

c. The painting equipment is used in the paint hangar only.

d. Painters will also be trained on the hazards associated with the painting fueled aircraft and the fire/safety problems associated with the process.

e. All safety and regulating features on associated spray painting equipment and safety equipment will be operational.

f. No unauthorized personnel are allowed in paint hangar during fueled aircraft painting operations.

g. Any personnel involved in operations in the paint hangar, even those not associated with the painting process, will be briefed on the hazards of static on ungrounded objects and provided the appropriate safeguards.

h. All aircraft, equipment, work stands, solvents containers/buckets, people, and adjacent equipment will be grounded prior to using the painting equipment.

i. Prior to cleaning electrostatic paint guns, the operators will ensure that they and the gun are grounded, and that the equipment is de-energized. All spray nozzles and auxiliary equipment being cleaned with flammable solvents shall be done inside the paint hangar facility with the ventilation system operating.

j. The manufacturers operational/safety procedural criteria is used as a supplement to the foregoing procedures.

k. All electrical equipment within the paint hangar facility must be approved for explosion proof environments. The painting equipment used for this process must have been tested and approved by a recognized laboratory for Class I, Division I, Groups C and D usage.

l. When painting fueled aircraft, the paint hangar facility and aircraft shall be protected with both overhead and underwing Aqueous Film Forming Foam (AFFF) suppression system. The AFFF system must be fully operational prior to the start of electrostatic painting.

m. Supervisory personnel must ensure all fire/safety countermeasures have been implemented prior to the start of the painting operation.

n. Lower Explosive Limit (LEL) readings in the fuel vent areas must be taken prior to the painting of each aircraft. LEL readings must be maintained at or below 20 percent.

### 3-121A. PAINTING OF AIRCRAFT, FIELD LEVEL OPERATIONS.

#### CAUTION

Electrostatic spray painting of JP-8 fueled aircraft constitutes a significant hazard when the on-board fuel temperature exceeds 100 degrees F.

a. Electrostatic or conventional painting of aircraft at field level shall be limited only to maintenance (touch-up) painting operations as defined by TO 42A-1-1. Maintenance painting is permitted in designated paint areas identified and approved using the requirements outlined in TO 42A-1-1. Base Fire, Safety, Bioenvironmental, and Environmental Management Offices shall approve locations for spray painting aircraft. Aircraft containing JP-5, JP-8, or equivalent fuel may be electrostatically painted at field level organizations,

providing the on-board fuel temperature is below the flash point of 100 degrees F before electrostatic painting operations begin. The aircraft being electrostatically painted must be grounded in two locations to prevent accidental electrical discharge from the electrostatic spray equipment. Each base is responsible for establishing procedures to ensure that the temperature of on-board fuel is below 100 degrees F before and during electrostatic painting applications.

b. The requirements for aircraft painting outlined in T.O. 42A-1-1, and AFOSH Std 127-17 will be strictly followed.

c. Personnel involved in painting operations of fueled aircraft will be trained on the fire/safety and environmental hazards associated with the process.

d. All safety and regulating features on associated spray painting equipment and safety equipment will be operational.

e. Unauthorized personnel will not be allowed in designated paint areas during painting operations.

f. Prior to commencement of painting operations ground all aircraft, metal solvent containers, flammable waste containers, airless and air assisted paint spray equipment. Grounding of adjacent equipment is as deemed necessary by the Base Safety Office.

g. Supervisory personnel must make sure all fire/safety countermeasures have been implemented prior to the start of the painting operations.

h. Lower Explosive Limit (LEL) readings at the fuel vent areas must be taken prior to the painting of each aircraft. Readings must be maintained at or below 20 percent LEL.

3-122. ATMOSPHERIC CONDITIONS FOR PAINTING. Coatings normally should not be applied under unfavorable atmospheric conditions such as high humidity, strong drafts or extremes of temperature.

3-123. Painting should be accomplished whenever possible in an environmentally controlled facility capable of maintaining a range of 30 to 80 percent relative humidity and 50°F to 80°F. Some coatings may be applied outside of these ranges without adverse effects; however, paint personnel should watch for adverse effects when applying paint outside of these ranges and develop painting decisions based upon local experiences for the particular types of coatings used and the local climate. Factors to be considered are:

a. The temperature of surfaces to be painted should be considered to any painting decision since that will be the controlling factor in the drying or cure of the applied coatings.

b. Low humidity may retard the cure of moisture curing (addition curing) coatings.

c. High humidity may result in blush of lacquers and also may introduce a risk of condensation or sweating should the temperature drop to the dew point.

d. Low temperatures may result in slow drying, slow cure, longer tack time, or incomplete cure.

e. High temperatures may result in too rapid an evaporation of solvent which may lead to premature skinning, pinholes, blisters, or cracked finish, or excessive dry spray.

f. The aircraft skin temperature must be at least 60°F prior to any application of coatings. During cold weather, this may require placing the aircraft in a heated paint facility several days in advance to ensure proper skin temperature.

### 3-124. AIRCRAFT PAINTING SEQUENCE.

3-125. Application of coatings to aircraft by conventional spraying methods is best accomplished by at least two painters supported by helpers in handling line, stands, etc., as required. Four painters may sometimes be employed on larger aircraft. A recommended painting sequence is as follows:

a. Initial application is to the underside of the aircraft fuselage and wings, with each painter starting at the wing tip and working toward the center of the fuselage. The initial direction of the paint application should be perpendicular to the leading edge of the wings. The second coat or cross coat is applied immediately upon completion of the first coat with each operator again starting at the wing tips and working toward the aircraft fuselage. The direction of this second coat or cross coat should be parallel to the leading edge of the

wings. This procedure of cross coating immediately is possible only because the surfaces are in an approximately horizontal plane and sags, streaks, and/or excessive orange-peel are not encountered.

b. Horizontal elements of stabilizers are painted next. The first coat is applied perpendicular to the leading edge of the stabilizers, starting at the top of the vertical stabilizer, continuing across the upper surface of the horizontal stabilizer, and finishing on the underside of the horizontal stabilizer at the fuselage junction. The second coat or cross coat is applied after a few minutes pause with each paint operator repeating the first coat procedure; however, the direction of this second coat or cross coat is parallel to the leading edge of the stabilizer.

c. The fuselage is coated next, with each operator applying the coating material from the aft to the forward part of the fuselage. The first coat is applied lengthwise of the surface with the final coat or cross coat applied crosswise to the aircraft length. This procedure has been found to produce the least amount of surface defects on the aircraft surface.

d. The upper surfaces of each wing are then painted with the operators again starting at each wing tip and working toward the fuselage. Due to the horizontal position of the wings immediate cross coating is authorized as the operator works toward the fuselage. The area cross coated is determined by the reach of the individual operator and normally covers a 3-foot section of the wing surface extending from the leading edge to the trailing edge of the wing.

e. Techniques of application outlined in this section apply.

### 3-126. SPRAY TEST PANELS.

3-127. To test suitability of material, conditions, etc., test panels should be sprayed prior to beginning operations. The suitability shall be determined

experimentally on a panel approximately 10 x 32 inches in size. The panel shall be coated under prevailing conditions with the finish system that is to be applied. If the finish system applied to the experimental panel is satisfactory, then full scale operations may begin. Defects found in the experimental application such as blushing, poor adhesion, excessive orange peel, sagging, etc., shall be corrected prior to large scale application. Catalyzed (2 component) coatings or long dry time enamels usually cannot await inspection of cured and dry paint films before they must be applied. Spray the test panels and use the best information available at the beginning of the application to determine the condition of the coating and the suitability of the materials. Test panels are not required for component or maintenance painting (touch-up).

### 3-128. GUN TECHNIQUES.

3-129. Spray guns (and spray coatings) are designed to be used with certain spraying techniques. Quality of finish will depend on how well these techniques are used. Spraying techniques include the following.

3-130. DISTANCE. Depending on the desired width of the spray pattern, the gun is held 6 to 10 inches from the work (A, Figure 3-6). If all other adjustments are correct, greater distance will result in dry spray or dusting and excessive overspray. Holding too close to the work will result in too heavy coatings with a tendency to sag or run.

3-131. STROKING. The essence of proper stroking is maintaining the same distance from the work, the same speed, and the same perpendicularity of the gun to the surface as possible throughout the pass. The natural tendency for spray painters, particularly when fatigued or in an uncomfortable position, is to arc or wave the gun (B, Figure 3-6). This practice must be avoided at all costs. In general, wrist movement must be eliminated in stroking. A flexible wrist almost inevitably causes the gun to describe a curve instead of remaining parallel to the surface. This causes a thicker coating to be applied in the middle of the stroke than at the end. (An exception to the rule is in spotting during touch-up. Here it is permissible to fan the gun to lay down a spot which is thinner at the edges in order to blend into the large painted area.) Special pains must be taken, particularly when applying coating materials with poor flow characteristics (such as vinyl paints) that the gun is held perpendicular to all surfaces (flat or contoured) as they are passed. If this is not done, the irregular spray pattern formed will lay down uneven thicknesses and cause uneven drying. Protrusions such as screw heads, etc., present surfaces that will require facing the gun in several directions to completely coat them. It may be advisable to spot paint

these in advance. The rate of the stroke should be uniform and such as to lay down a full wet coat of material. Stroking should be in parallel passes with each stroke aimed for a 50 percent overlap, or so that the middle of the spray pattern strikes the wet bottom edge of the previous stroke (Figure 3-7). In order to ensure good coating integrity and coverage, an effort shall be made to cross coat alternate layers of the coating system (see Figure 3-8).

3-132. TRIGGERING. Proper triggering of the gun is difficult to learn and can only be developed by practice. It is a matter of judgment and sensitivity of touch and variations of triggering technique may be called for in special situations. In general, the painter should begin his stroke before triggering the gun and release the trigger before stopping the stroke. It can be compared to the follow-through in swinging a golf club. It is intended to feather out the end of a stroke so that the end of a succeeding overlapping stroke will blend into it. Examples of correct techniques are shown in Figure 3-6.

### NOTE

A reasonable amount of care will maintain spray guns and spray equipment in top operating condition and prevent a majority of spraying difficulties. Thorough cleaning immediately after use and appropriate lubricating are essential.

### 3-133. GUN ADJUSTMENTS.

### NOTE

This manual provides only general information for spray guns. See specific manual of manufacturer's booklet for detailed operating and maintenance instructions.

3-134. In spray painting, the flow of air and fluid at the gun must be adjusted or balanced to obtain proper atomization and other desired spraying characteristics. The first consideration in obtaining this balance is proper combination of air cap and fluid tip for the particular material being sprayed according to the instructions of this technical manual or the equipment manufacturer's recommendations. After the air cap and fluid tip have been selected, there are several adjustments which may be made on the gun controls to bring to perfect balance the air and fluid relationship required by the job and conditions. The fluid adjusting screw on the gun (B, Figure 3-9) permits restriction of fluid flow in proportion to the volume of air being used. This method may be used only to a certain point since it puts additional tension on the gun trigger and will tend to discourage feathering of the stroke. More effective (in pressure feed

spraying) is the adjustment of tank pressure and adjustment of the atomization air supply to the gun to obtain the air-fluid balance for a specific combination of air cap and fluid tip. The pattern adjustment screw (A, Figure 3-9) can be changed to spread the atomized fluid out over a greater area which, in combination with the increased air flow, is equivalent to reducing the flow of fluid.

#### NOTE

Do not thin the paint excessively in order to increase the flow of fluid.

3-135. The atomizing pressure to be used is dependent upon the type of coating and length and diameter of the air line from the regulator to the gun, but it should be sufficient to completely atomize the material being sprayed and no greater. With 100 feet of 5/16 inch air hose and enamel of rather heavy

viscosity, a pressure of 50 to 60 psi at the regulator usually gives satisfactory results. An excessive concentration of air may give a split pattern or one which is light in the center insofar as deposited material is concerned; too little air may give a heavy centered pattern (Figure 3-10). Pressure on the paint pot is usually adjusted between 25 and 40 pounds but may vary more widely, depending on the unit weight of the paint and its elevation above the pressure tank. In normal operation the wings on the nozzle are in the horizontal position. This provides a vertical fan-shaped pattern which will give maximum coverage as the gun is moved back and forth parallel to the surface being painted. The spray pattern is variable from round to flat with all patterns in between and can be adjusted to obtain the pattern which will produce the best results.

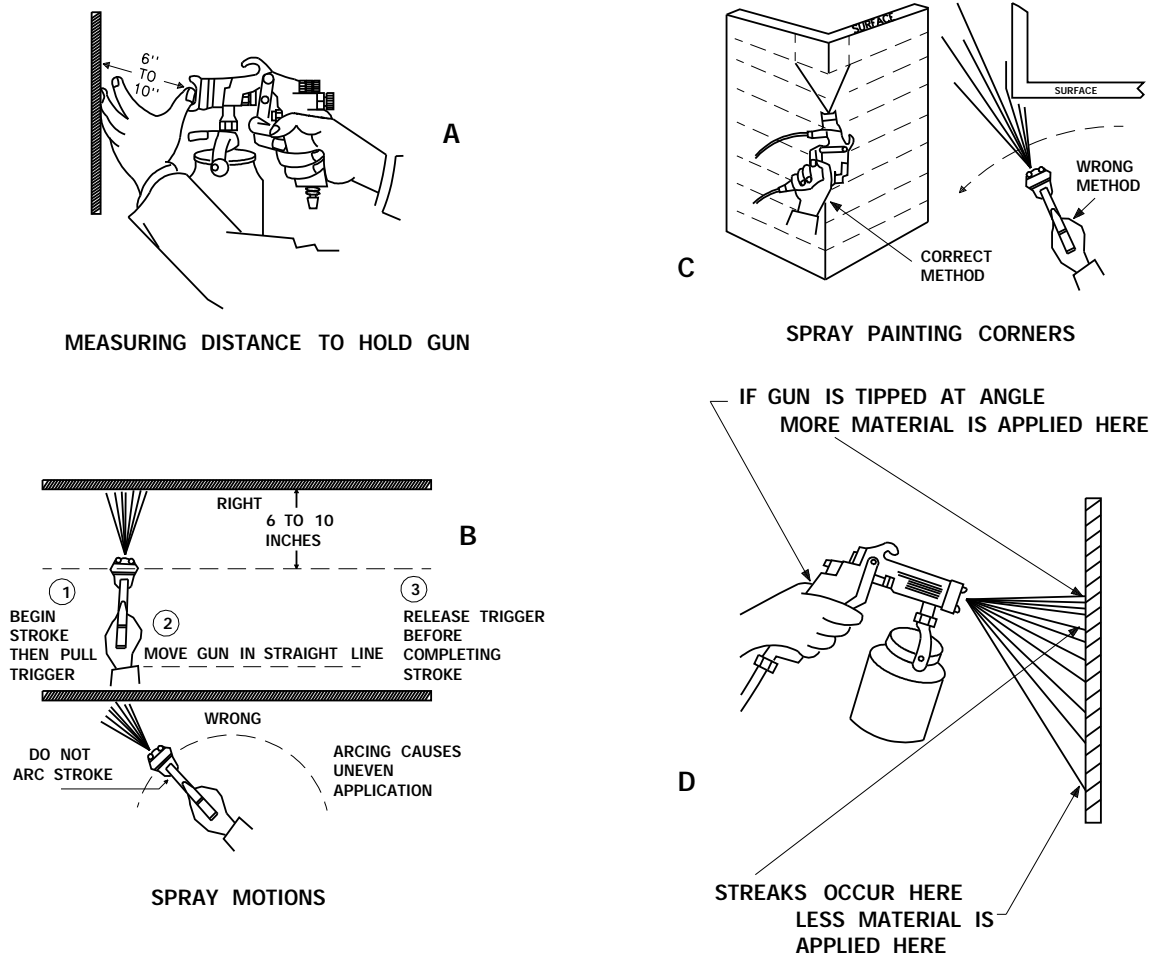


Figure 3-6. Right and Wrong Methods of Spraying

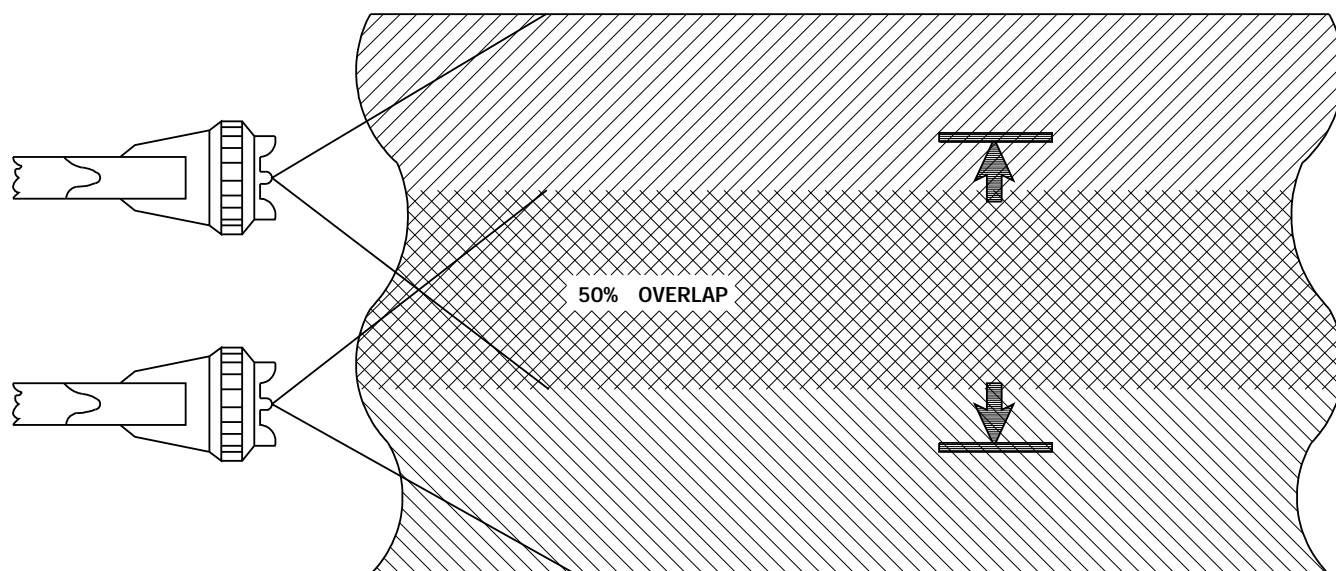
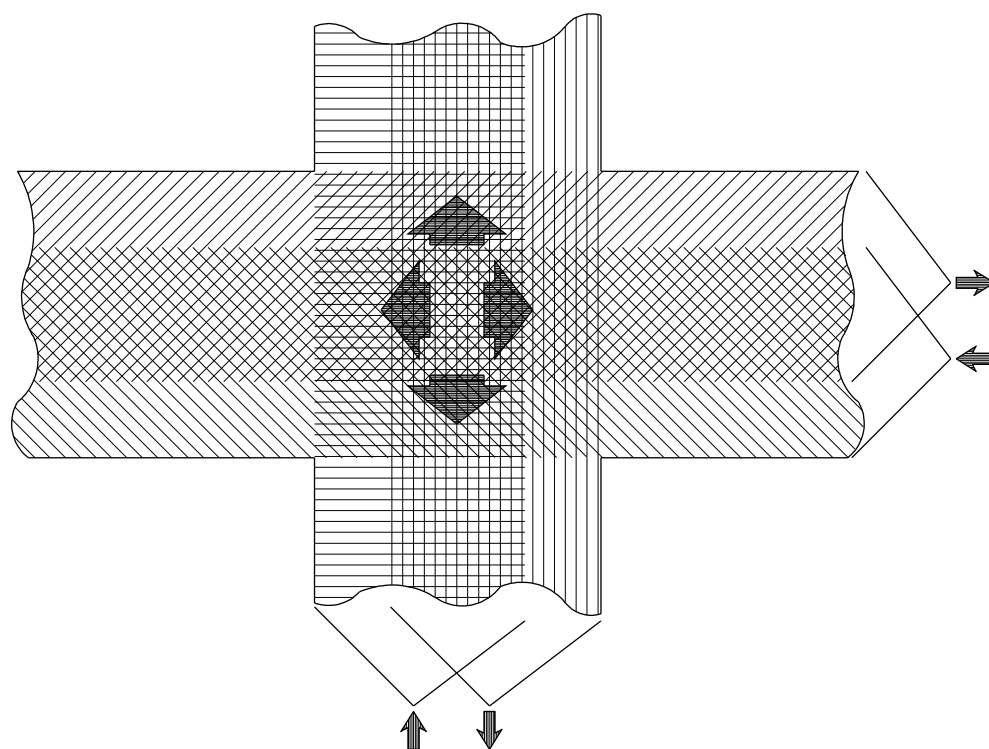


Figure 3-7. Fifty Percent Overlap



HALF OF TOTAL COATS SHOULD BE CROSS-COATED

Figure 3-8. Cross-Coating



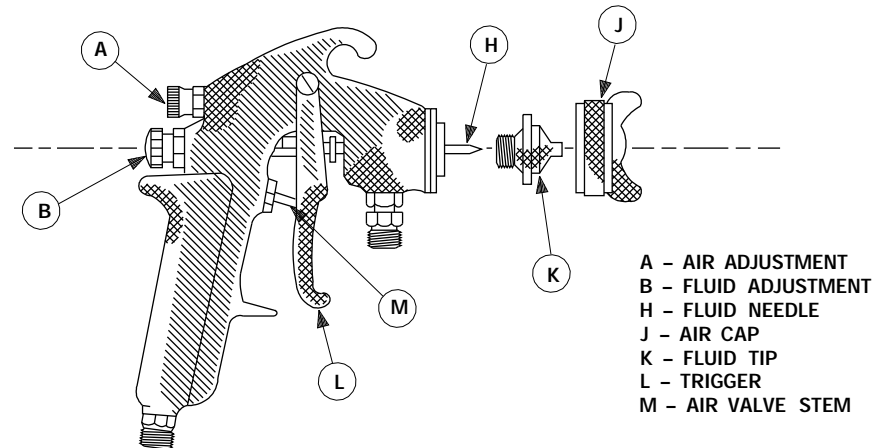


Figure 3-9. Spray Gun Adjustments

a. Adjust spray pattern with spray adjusting screw on back of gun. Turn right for round, left for the fan pattern.

b. Adjust material control screw immediately below spray adjusting screw to supply the correct amount of paint. Turn to right to decrease flow, left to increase.

#### NOTE

As the width of the spray is increased, more paint must be allowed to pass through the gun to get the same coverage on the increased area.

#### 3-136. PAINTING DIFFICULTIES AND REMEDIES.

3-137. Coating troubles may be divided into five groups: (1) Inadequate surface preparation, (2) Incorrect methods or techniques of application, (3) Unusual climatic and atmospheric conditions, (4) Unsuitable equipment, and (5) Faulty finishing material. An experience finisher may be capable of adjusting to obtain proper results with faulty materials, but this is an emergency measure only and must be with the cognizance and authority of the quality control facility. Incorrect methods of application should be discontinued upon discovery of the discrepancy. Conditions such as adverse weather and humidity may often seem to limit choice of application method to one which is unworkable. Consideration should always be given to alternate methods

such as hot-spraying in lieu of conventional spraying or even brushing and roller coating on certain surfaces. Remedying incorrect techniques of application, however, calls for training. The practice of allowing inadequately trained personnel to apply coatings, particularly to aeronautical surfaces, is unauthorized and dangerous. Unusual climatic and atmospheric conditions can be to some extent remedied or compensated for by space heating, humidity control, shielding from elements, etc. Unsuitable or faulty equipment can only be remedied by obtaining proper equipment or repair. Table 3-1 lists common troubles of spray coating operations with suggested remedies or methods of avoidance.

#### 3-138. FILM THICKNESS (AIRCRAFT SURFACES).

3-139. Various factors have entered into the determination of optimum film thicknesses. They are a physical requirement for developing the full capabilities of coatings. Films applied either too thick or too thin will have reduced durability in service. See Section IV for recommended film thicknesses applicable to standard coatings for aircraft. When other coatings are being applied, see manufacturer's instructions for recommended thickness.

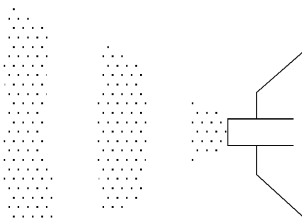
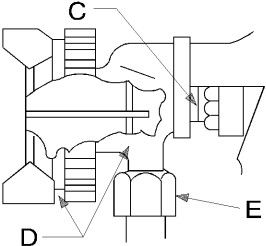


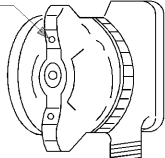

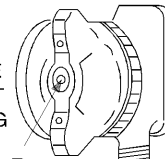

PATTERN	CAUSE	CORRECTION
	<p>(A) DRIED OUT PACKING AROUND MATERIAL NEEDLE VALVE PERMITS AIR TO GET INTO FLUID PASSAGEWAY. THIS RESULTS IN SPITTING.</p> <p>(B) DIRT BETWEEN FLUID NOZZLE SEAT AND BODY OR A LOOSELY INSTALLED FLUID NOZZLE WILL MAKE A GUN SPIT.</p> <p>(C) A LOOSE OR DEFECTIVE SWIVEL NUT ON SIPHON CUP OR MATERIAL HOSE CAN CAUSE SPITTING.</p>	 <p>TO CORRECT CAUSE (A), BACK UP KNURLED NUT C, PLACE TWO DROPS OF MACHING OIL ON PACKING, REPLACE NUT AND TIGHTEN WITH FINGERS ONLY. IN AGGRAVATED CASES, REPLACE PACKING.</p> <p>TO CORRECT CAUSE (B), REMOVE FLUID NOZZLE D, CLEAN BACK OF NOZZLE SEAT IN GUN BODY USING RAG WET WITH THINNER, REPLACE NOZZLE AND DRAW UP TIGHTLY AGAINST BODY.</p> <p>TO CORRECT CAUSE (C), TIGHTEN OR REPLACE SWIVEL NUT E.</p>
	<p>A FAN SPRAY PATTERN THAT IS HEAVY IN THE MIDDLE, OR A PATTERN THAT HAS AN UNATOMIZED "SALT-AND-PEPPER" EFFECT INDICATES THAT THE ATOMIZING AIR PRESSURE IS NOT SUFFICIENTLY HIGH.</p>	<p>INCREASE PRESSURE FROM YOUR AIR SUPPLY. CORRECT AIR PRESSURES ARE DISCUSSED ELSEWHERE IN THIS INSTRUCTION SHEET.</p>
	<p>DRIED MATERIAL IN WING PORT "A" RESTRICTS PASSAGE OF AIR THROUGH IT AND PRODUCES A CRESCENT FULL PRESSURE OF AIR FROM CLEAN WING PORT FORCES PATTERN IN DIRECTION OF CLOGGED SIDE.</p> 	<p>DISSOLVE MATERIAL IN SIDE PORT WITH THINNER. DO NOT POKE IN ANY OF THE OPENINGS WITH METAL INSTRUMENTS.</p>
	<p>SPRAY PATTERN WIDER AND HEAVIER AT EITHER END IS CAUSED BY DRIED MATERIAL AROUND THE OUTSIDE OF THE FLUID NOZZLE TIP. B RESTRICTS THE PASSAGE OF ATOMIZING AIR AT ONE POINT THROUGH THE CENTER OPENING OF AIR NOZZLE AND RESULTS IN PATTERN SHOWN. THIS PATTERN CAN ALSO BE CAUSED BY LOOSE AIR NOZZLE.</p> 	<p>IF DRIED MATERIAL IS CAUSING THE TROUBLE, REMOVE AIR NOZZLE AND WIPE OFF FLUID TIP, USING RAG WET WITH THINNER. TIGHTEN AIR NOZZLE.</p>
	<p>A SPLIT SPRAY OR ONE THAT IS HEAVY ON EACH END OF A FAN PATTERN AND WEAK IN THE MIDDLE IS USUALLY CAUSED BY (A) TOO HIGH AN ATOMIZING AIR PRESSURE, OR (B) BY ATTEMPTING TO GET TOO WIDE A SPRAY WITH THIN MATERIAL.</p>	<p>REDUCING AIR PRESSURE WILL CORRECT CAUSE (A). TO CORRECT CAUSE (B), OPEN MATERIAL CONTROL TO FULL POSITION BY TURNING TO LEFT. AT THE SAME TIME TURN SPRAY WITH ADJUSTMENT TO RIGHT. THIS WILL REDUCE WIDTH OF SPRAY BUT WILL CORRECT SPLIT SPRAY PATTERN.</p>

Figure 3-10. Faulty Patterns and Suggested Corrections

3-140. Because of the greatly reduced corrosion inhibiting effectiveness and coverage in dried film thickness of less than 0.3 mils (0.0003 inch), solitary primer films below this thickness should be avoided. Attaining proper coating thickness by spraying is a matter of technique plus checking. There is a limit to the thickness that can be applied at one pass because of protracted drying time or possible sagging of the film, and often this must be considered in obtaining the ultimate desired thickness. Also, there is a tendency with coating materials of good hiding power to increase the spreading rate as the work progresses and this must be curbed. Operator fatigue may alter the speed of working, but this should not be allowed to result in feeding more or less material to the surface. Changing atmospheric conditions during operations may have to be compensated for to continue applying a uniform film. Frequent checks with a wet film thickness gage, should be made during painting to ascertain and control film thickness. Thickness cannot be gaged accurately without instruments, but, lacking these, the best assurance of consistent films is in correct adjustment of gun and material and the use of good judgment.

#### 3-141. COATING THICKNESS MEASUREMENTS.

3-142. Wet and dry film gages are available as local purchase items from various laboratory supply houses. If paint film thickness measuring instruments are not available, small (5 x 16 inches) anodized aluminum panel will be employed for the measurement of the paint thickness after drying. These panels will be applied to each side of the fuselage prior to the painting operation. One end of the panel should be masked with tape for a distance of approximately 2 inches to provide a comparison of the original panel thickness and the thickness of the completed paint system. Removal of the panel after application of the primer is recommended so that immediate maintenance painting operation can be employed to cover those areas previously protected by the panel. This procedure will also permit relocating of the panel on various portions of the same aircraft to provide a good indication of the overall paint thickness application. The location of the panel is dependent upon inspection procedures and may vary throughout the aircraft. Each aircraft should possess a panel for each operation employed on the aircraft and it should be identified by the name of the operator, aircraft model and the date of painting in order to provide follow-on data during any subsequent service evaluation. The panel is applied by the use of a small section of 1-inch width masking tape doubled upon itself with the adhesive side contacting the panel and the aircraft surface. Slight errors in paint thickness

measurements can exist due to thickness tolerances permitted by the basic aluminum procurement specification. This factor must be taken into consideration in the measurement of the thickness of the paint deposit. Measurement of the paint thickness is best accomplished by the use of an ordinary micrometer possessing flat contact surfaces. Micrometer possessing pointed or rounded contact surfaces are not recommended. At least 6 readings should be taken on both painted and unpainted portions of each area to be qualified to provide an average paint thickness measurement. When using a wet film gage or an Electronic Dry Film Gage, a minimum of 6 readings should be taken. These readings should be taken in a 1 square foot area that is representative of the entire area to be qualified. The area to be qualified should be rejected only if the average of the 6 readings falls outside of the thickness range for that particular paint system.

#### 3-143. INSPECTION CONTROL.

3-144. Inspection shall enforce the requirements of this technical manual.

a. Proper and adequate equipment shall be used at all times.

b. Materials shall be thoroughly mixed and thinners or catalysts properly proportioned.

c. It must be assured that thorough cleaning and proper preparations are taken prior to application of each coat to the exterior of aircraft, that proper drying times are observed before recoating and that proper coating thicknesses are applied.

d. The general appearance, texture, color, and gloss shall be acceptable. No sand paper finish to exceed approximately 600 grit coarseness, wrinkling, crazing, blistering, fisheye, lifting, or pitting/cupping as defined in this manual should be considered permissible.

e. Certain physical tests shall be made before, during, or after coating operations:

(1) Water Break Test (refer to paragraph 3-12).

(2) Spray Test Panel (refer to paragraph 3-126).

(3) Coating Thickness Measurement (refer to paragraph 3-141).

(4) Adhesion (Wet) Tape Test. This method covers a procedure suitable for establishing acceptability of intercoat and surface adhesion of an organic coating system.

(a) Adhesion tests shall be made on the completed exterior finish on the painted area after

drying for a period of at least 48 hours on a sufficient number of selected areas to assure that a satisfactory level of adhesion has been maintained overall.

(b) In performing this test it is suggested that a piece of wet cloth be covered with plastic and taped on the area under inspection. The test area shall be kept soaked 24 hours minimum with tap or distilled water. The test area shall have a minimum diameter of 3 inches.

(c) Remove the wet cloth and blot up the surface water. Immediately apply a 1 inch strip of tape, (Code No. 250 Minnesota Mining and Manufacturing Company age of tape not to exceed 3 years) adhesive side down. Press the tape down, using two passes of a 4 1/2 pound rubber covered roller or employ firm pressure with the hand.

(d) Remove the tape in one abrupt motion and examine the tested area for any paint damage such as removal of paint at one of the layers of the finish system or removal of the entire system from metal.

(5) Gloss shall be measured in accordance with the general outlines described in Federal Test Method Standard 141, Method 6101, except that the measurements will be made on flat or approximately flat surfaces of the aircraft instead of a test panel. The test shall be made on the complete exterior finish after drying for a period of at least 24 hours, and shall be made on a sufficient number of areas to assure that the required gloss has been obtained. See Table 3-1.

Table 3-1. Gloss Requirements

Gloss Meter Degrees	Paint System	Reading Units
60	Semigloss	35-45
60	High Gloss	90 Min.
60	Gloss	80 Min.
60	Camouflage	7 Max.
60 and 85*	Gunship*	3 Ea Max.

\*Both meters required.

f. Evaluation and classification of discrepancies for complete aircraft painting.

(1) The paint system, pattern, and markings shall be in accordance with TO 1-1-4, aircraft drawings or other applicable directives.

(2) Colors of camouflage pattern shall fade/blend into each other with irregular lines of demarcation, no straight or sharp lines.

(3) No color variation in any single color area of the camouflage pattern or paint scheme when the surface is viewed with the unaided eye from a distance of 50 feet is allowed. Touch-up of the paint system to correct minor discrepancies by the paint activity will produce some minor color variation and is acceptable.

(4) No more than 2 minor sags/runs per 50 square feet of surface is allowed (a minor run is one which does not exceed two inches in length).

#### NOTE

Slight orange peel appearance is inherent with the MIL-P-87112 (PR-143 2GP) polysulfide primer/MIL-C-83286 polyurethane paint system and is acceptable.

(5) The paint system shall pass the paint adhesion wet tape test. Candidate test areas shall include the following (where applicable): Upper center wing, left and right upper inboard and outboard wing, left and right lower wing surface (inboard and outboard), left and right horizontal stabilizer surface (upper and lower), left or right side of vertical stabilizer, cargo door, MLG POD, engine pylon, engine nacelle, left and right side of fuselage forward and aft), lower fuselage or belly (multiple sites will be selected for this area). A quality assurance inspection shall select the exact test locations and perform the test. Failure of this test includes peeling of topcoat to primer as well as primer to bare metal.

(6) Fifteen or more individual discrepancies, any combination of discrepancies with a total area of 15 or more square feet, or any one discrepancy with an area of 5 or more square feet wrinkling, crazing, blistering, lifting, or pitting/cupping as defined in this TO or peeling of topcoat to primer or primer to bare metal shall be reported as a major defect. List all these discrepancies by number found and type, area of each, and total area of all discrepancies.

**NOTE**

Failure of 25 percent of the wet tape adhesion tests prescribe here shall be reported as major defect. List all failures of this test by location on the aircraft.

g. Frequency of Inspection. The quality control plan and frequency of inspection shall be decided by local quality control authority. For large surface painting (e.g., the partial or complete repaint of an aircraft), a predetermined number of tests may be applied to sampled areas of each item. For subassembly and component painting, inspection of paint shop workmanship may be covered by in-process inspection or inspections of representative article of output according to a sampling plan either on a time basis or production count basis. Testing should be kept to the minimum to determine acceptability of the finished work. System/Item Managers have the option to specify a frequency of test in technical orders or work specifications on their equipment.

### 3-145. OVERSPRAYING EXISTING COATING SYSTEMS ON AIRCRAFT.

3-146. It is always better to start a paint system from bare metal, however, when authorized by TO 1-1-4, it is feasible to overspray existing paint systems.

**NOTE**

Adhesion failure between coatings will require complete removal of the non-adhering coating. When inter-coat adhesion failure occurs over large areas, overcoating shall not be accomplished and complete strip/repaint is required.

a. Aircraft exterior painted surfaces shall initially be cleaned in accordance with TO 1-1-691 and thoroughly inspected to determine the soundness of the paint film. Areas of severely deteriorated paint as indicated by loose or peeling paint and contamination from hydraulic or engine oil, fuel or other fluids or where bare metal is showing shall be stripped per Section II of this manual.

b. Mask all areas which may be damaged by entry of fluids or paint dust generated during the cleaning and scuff sanding operations per Section II of this manual.

c. Prepare the surface of overcoating by either the scuff sanding or the enzyme wash method below:

**CAUTION**

To prevent static discharge from igniting dust particles, the aircraft shall be grounded, and workstands and powered support equipment shall either be grounded or bonded to the aircraft during the sanding operation. Provide adequate ventilation/air flow and use only pneumatic sanders. All personnel performing or in the vicinity of the sanding operation shall wear a dust/particulate type protective face mask to prevent inhalation of the organic paint dust. Maintain a minimum distance of 50 feet between the area in which the sanding operation is performed and all possible sources of ignition.

(1) Scuff Sanding.

(a) Completely scuff sand the entire exterior surface of the aircraft, excluding bare metal areas, using abrasive paper no coarser than 180 grit, 3M Corp medium grade aluminum oxide surface conditioning discs, or MIL-A-9962, Type I, Grade C abrasive mat. Scuff sanding shall include roughing up 100% of the surface and removal of oxidized and flaked paint and is not intended to remove a sound paint system. Light scuffing is sufficient for adhesion of the primer tie coat to a sound topcoat. Do not sand through to bare metal as damage to the aircraft may occur. All areas where the paint system is nicked, scratched, or chipped and the edges of the paint system surrounding areas where paint has been removed are to be feathered out (blended smooth) during the sanding operation.

(b) Using a heavy duty pneumatic wet-dry vacuum cleaner, vacuum all sanding debris from the surface.

(c) Immediately after vacuuming, apply MIL-C-5541/MIL-C-81706, Class 1A conversion coating to all bare metal (aluminum alloy) areas per instructions in paragraph E-14.3 of TO 1-1-691 to include all areas where paint system is nicked, scratched, or chipped through to bare metal. These areas shall be abraded and cleaned per instructions in paragraph E-14.3 of TO 1-1-691 prior to application of the conversion coating solution.

(d) Allow at least 2 hours for the MIL-C-5541/MIL-C-81706, Class 1A conversion coating to dry and set up; and, then move the aircraft to the paint hangar with no delay in the outside environment if movement of the aircraft is required.

(e) After the aircraft is situated in the paint facility, or after 2 hours minimum has elapsed since rinsing the conversion coating solution from the aircraft, wipe the entire aircraft surface with a lint free cotton cloth conforming to DDD-R-30 or cotton gauze/cheese cloth wetted with MIL-T-81772, Type 1 Thinner. Wipe the surface dry with a clean cotton cloth of the same type. Do not

allow drying of the surface by evaporation as this allows contaminants to redeposit on the surface. This solvent wipe process should be done as close as possible to paint application to prevent contamination.

(2) Enzyme Cleaning. Alternate to scuff sanding; accomplish in the paint hangar.

### 3-147. DRYING OF FINISHES.

3-148. After painting, permit aircraft to dry in a dust-free atmosphere for a sufficient time prior to placing in service. In the absence of accelerated drying the aircraft should not be flown for at least 72 hours after painting. In general, all painted aircraft should be handled, taxied, etc., as little as possible during the first week after painting.

### 3-149. INTERIOR FINISHING PROCEDURES AND OPERATIONS.

3-150. PREPARATION OF COATINGS. Anodizing or chemical surface treatment of metals and metal parts is a necessary prerequisite on all interior surfaces which are to be painted prior to priming and painting operations. In addition, the cleaning requirements outlined in Section II apply.

3-151. APPLICATION OF COATINGS. Where wash primer is prescribed for interior surfaces it must be followed by TT-P-1757 and both must be applied in the same manner and with the same precautions and restrictions as are prescribed for external finishing elsewhere in this technical manual. Other interior surfaces, where wash primer is not a specific requirement, shall be finished with MIL-P-23377 epoxy primer applied directly on treated metal. MIL-P-85582 water borne epoxy primer shall be used to touch up areas where TT-P-1757 zinc chromate primer might be overcoated, as solvents in MIL-P-23377 may cause the TT-P-1757 to soften and flake off. If appearance is of concern, either epoxy primer may be topcoated with TT-P-1757. The application of primer shall be in conformance with this technical manual (Section IV). For areas specified to be other than interior green color, Specification MIL-1-19537 lacquer for high gloss or Specification MIL-1-19538 for low gloss finish in the required color, shall be applied on the primer in the same manner and with the same precautions and restrictions as are prescribed for exterior finishing elsewhere in this technical manual. The acrylic nitrocellulose finish system of wash primer, lacquer-type primer, and acrylic nitrocellulose topcoat may be used for the interior surfaces, if desired; but in the case of aircraft subject to spillage or leakage of diester oil or diester grease this finish is mandatory on the interior surfaces subject to contamination. In any event, it shall be used on such aircraft on the following specific interior surfaces: wheel wells and their doors, speed brakes, engine access doors, main landing gear doors when topcoats or color other than interior green or yellow primer color is prescribed by the procuring activity. The interior colors prescribed by Specification MIL-C-8779 shall be applied in the locations called out in that specification.

### 3-152. REFINISHING OF FIBER GLASS REINFORCED PLASTIC SKINS.

- a. Remove the topcoat.

**WARNING**

Provide adequate ventilation when using 50/50 mixture of MEK and Toluene. Avoid prolonged breathing of vapors and avoid skin contact. Use appropriate protective gloves. Contact Bioenvironmental Engineering to determine need for respiratory protection.

- (1) Remove lacquer with MIL-T-19544 lacquer thinner, TT-M-261 (methyl ethyl ketone) or TT-M-268 (methyl isobutyl ketone).

- (2) Remove polyurethane by sanding to the epoxy (yellow) primer.

- b. Thoroughly solvent clean the surface using 50/50 mixture of MEK and Toluene.

- c. On the (yellow) epoxy-primed surface:

- (1) Sand the surface with 280 grit abrasive paper and solvent clean. Do not sand through the primer.

- (2) Reactivate the surface with MIL-T-81772 thinner.

- (3) Apply 1 coat of MIL-P-23377 epoxy primer.

- (4) Apply 2 coats of MIL-C-83286, polyurethane topcoat.

3-153. SOIL BARRIER COATING. This coating shall be applied to all newly painted aircraft in the following areas: Jet engine exhaust, APU exhaust, gun/rocket blast exhaust, flap wells, and wheel wells. This coating will protect the newly painted surfaces until the aircraft is cleaned. If left unprotected, the above areas will be very difficult to clean after exposure to the aforementioned exhausts. This material and application procedures are called out in TO 1-1-691. The soil barrier coating shall be applied after 24 hours cure time of the topcoat and prior to engine run-up.

### 3-154. GENERAL APPLICATION OF COATING SYSTEMS.

3-155. Two of the major causes for premature failure of coating systems are: (1) inadequate surface preparation and (2) poor application. Included in this section are detailed application procedures for several coatings systems used in the Air Force, including the USAF standard polyurethane system and the former standard acrylic nitrocellulose lacquer. These procedures are written primarily for depot level use, however, they also apply to field level

maintenance wherever capabilities exist. Maintenance painting techniques peculiar to each system are presented, with references for general procedures and techniques applicable to all systems.

3-156. USAF STANDARD POLYURETHANE AIRCRAFT COATING SYSTEM. (See TO 1-1-4 and aircraft -23 TO's and paint drawings for schemes, colors, and markings.)

3-157. Optional standard polyurethane paint systems consist of epoxy primer MIL-P-23377, polyurethane primer TT-P-2760, polysulfide primer MIL-P-87112 (PR-1432GP) or water reducible epoxy primer MIL-P-85582, topcoated with polyurethane coating MIL-C-83286 or high solids polyurethane coating MIL-C-85285, Type I. Most coatings formulated for these specifications are two-component materials and have been formulated for spray application.

#### NOTE

- Before applying, spray an aluminum panel to determine the suitability of the material. Observe the panel for blushing, sagging, or other defects detectable during or shortly after application. Correct the cause of any defect found before continuing. The preapplication panel is in addition to the one coated simultaneously with the aircraft and used to check the quality of the completed job.
- Since the epoxy and polyurethane cure (chemically react) rather than dry by evaporation, use only clean equipment for mixing and applying the system to prevent contamination of the materials. Clean the equipment immediately after use with a suitable solvent before the coatings set up.
- Cure accelerators are not authorized for use in painting aircraft exterior surfaces.
- Inadequate mixing or mixing in the wrong proportions will cause poor adhesion, slow or incomplete curing, and poor performance of the coating.

3-158. EPOXY POLYAMIDE PRIMER, MIL-P-23377F, TYPE I, CLASS 1.

a. Mixing. Thoroughly agitate components (Epoxy Resin Component A and Polyamide Converter Component B) preferably with a mechanical shaker prior to mixing and if required pour into separate measuring or metering containers. Mix, using manufacturer's directions, equal volumes of

the components (Component A and B) together and thoroughly agitate, best mixing results can be achieved with a mechanical shaker. Mix only materials from the same manufacturer and do not mix more material than can be used in a maximum 8-hour period. It is preferable that the amount mixed be limited to that usable in four hours. This primer is required to be agitated continuously during spraying applications to prevent settlement of pigment and ensure uniformity of color. After mixing, allow the primer to stand 30 minutes before applying. If in-line or in-head proportioning equipment is used to mix base and catalyst as the paint is being used, a 30-minute dwell time is not required before application.

b. Thinning. Strain the primer and adjust the viscosity by thinning to suit the process. A viscosity of 4 to 14 seconds in a No. 4 Ford Cup or (15 to 20 seconds in a No. 2 Zahn Cup) is a desirable range for the thinned primer. The addition of thinner in a ratio of one and one-half volumes thinner to 2 volumes of primer is normally used; however, refer to the manufacturer's data for any specific recommendations. Use thinner per MIL-T-81772, Type II.

#### WARNING

MIL-T-81772 is flammable and moderately toxic to eyes, skin, and respiratory tract. Eye and skin protection required.

c. Application. Apply one coat of epoxy primer to a dry film thickness of 0.6 to 0.9 mils (2.0 to 3.0 mils, wet film thickness). The primer will dry to touch in 45 minutes, and be satisfactory for recoating in one hour at 75°F and two hours at 60°F. Topcoating shall be accomplished within eight hours after application of the primer. After eight hours, the entire primed surface shall be scuff sanded with MIL-A-9962, Type I, Grade A abrasive mat and tack ragged before topcoat application. Discard any unused class I epoxy primer mixed for longer than eight hours.

3-158A. EPOXY POLYAMIDE PRIMER, MIL-P-23377F, Type I, Class 2.

a. Mixing. The Class 2 material under Revision "F" of MIL-P-23377 is a high solids (low VOC) formulation with a 340g/l (2.8 lbs/gal) VOC content. Mixing procedures are the same as for class I primer. Mix only materials from the same manufacturer, and do not mix more than can be used in a maximum 4 hour period.



b. **Thinning.** No thinning of this material is allowed for compliance with air quality regulations. Application viscosity will be approximately 24 seconds in a #4 Ford Cup (26 seconds in #2 Zahn Cup).

c. **Application.** Apply one coat of primer to a dry film thickness of 0.6 to 0.9 mils (1.0 to 1.5 mils wet film). Allow a minimum of five hours air dry at 75°F and ten hours at 60°F before application of topcoat. Since this epoxy primer has a very high solids content, cross coating is not required; and the spray gun must be kept moving to prevent excessive film build-up with subsequent reduction of adhesion. Apply a topcoat within 24 hours of primer application. After 24 hours, scuff sand the entire primed surface with MIL-A-9962, Type I, Grade A abrasive mat and tack rag the area prior to topcoating. Discard any class 2 primer mixed for longer than four hours.

### 3-159. WATER REDUCIBLE EPOXY PRIMER, MIL-P-85582, TYPE I, CLASS 2.

a. **Mixing.** See manufacturer's mixing instructions, as different manufacturers may have different mixing ratios and methods.

b. **Thinning.** Thin per the manufacturer's instructions as each manufacturer may have different thinning ratios and methods. Application viscosity will be approximately 14 seconds in a #4 Ford Cup (20 seconds in a #2 Zahn Cup).

#### NOTE

The volume of some primers may increase by 250% when properly thinned.

c. **Application.**

(1) The surface to be primed must be free of all contaminants and properly treated per TO 1-1-691. Areas that are not clean will not support the primer film, which will break into droplets; like a water break test. If this happens, the primer can be blotted up, the area wiped clean with a clean cloth dampened with MIL-T-81722, Type II thinner, and the primer reapplied.

(2) Purge spraying equipment lines with a mixture of 25% isopropanol alcohol and 75% water prior to application of the primer.

(3) Apply primer film thickness of 0.6 to 0.9 mils (2.5 to 3.8 mils wet film).

(4) Allow minimum of one hour air dry at 75°F or higher and 50% or less relative humidity, and a minimum of two hours at lower temperatures and high humidity. For adequate adhesion, the primer shall be topcoat within eight hours. After

eight hours, the primer shall be lightly scuff-sanded with MIL-A-9962, Type I, Grade A abrasive mat and tack-ragged before toapcoat application.

### 3-160. PRIMER COATING, ELASTOMERIC POLYURETHANE, TT-P-2760, TYPE I, CLASS 1.

#### WARNING

TT-P-2760 is moderately toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Consult Bio-environmental Engineering to determine need for respiratory and ventilation requirements.

a. **Mixing.** The primer is a one component, moisture curing polyurethane material that is not air quality compliant as it has a 590 g/l (4.9 lbs/gal) VOC content. It must be protected from moisture contamination to prevent premature curing. Do not open more containers of this primer than can be used. Once opened, the contents of a container should be used completely without resealing, and if not used, they should be disposed of properly. Since this is an one component material, no mixing is required, but shaking the primer for 8-10 minutes on a paint shaker is required as the pigment in the primer settles out rapidly. Pour the primer into a pressure pot immediately after shaking and check the can to see if all the pigment was mixed. If some pigment is remaining in the can, scoop some of the liquid in the pot back into the can, stir thoroughly with a wooden paddle, and pour all the contents back into the pressure pot. Close the pressure pot immediately after all the primer from the cans has been poured into it to minimize exposure of the primer to moisture in the air. If the pressure pot is kept tightly closed and the primer is not exposed to moisture, the pot life of the primer is unlimited. The shelf life of the primer in an unopened can is one year. Use only constant mixing pots with this primer to avoid pigment settling out.

b. **Thinning.** Thinning of this Class 1 primer is not required as viscosity as manufactured is correct for spray application. If thinning is done, it shall be with MIL-T-81772, Type I Thinner in the least quantity necessary to get the proper viscosity. The application viscosity will be approximately 14 seconds in a No. 4 Ford Cup (20 seconds in a No. 2 Zahn Cup).

c. **Application.** Apply one coat primer to a dry film thickness of 1.0 to 1.5 mils (3.3 to 5.0 mils wet film). The curing mechanism is a moisture reaction. The higher the humidity, the quicker the primer cures. The relative humidity must be within the ranger of 30% to 80% during application and

curing. If the humidity is less than 30%, add moisture by wetting the floor of the paint area with water or by an equivalent method. This Class 1 primer shall be cured per figure 3-10A before topcoating. If more than one week elapse before topcoating the primer, lightly scuff sand the entire primed surface with MIL-A-9962, Type I, Grade A, solvent, wipe with MIL-T-81772, Type I Thinner, and apply a mist/tie coat of this primer prior to topcoating.

### 3-161. PRIMER COATING, ELASTOMERIC POLYURETHANE, TT-P-2760, TYPE I, CLASS 2.

#### WARNING

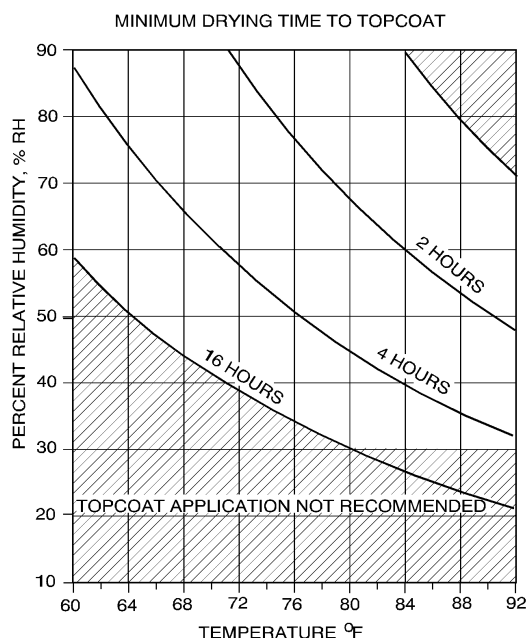
TT-P-2760 is moderately toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Consult Bio-environmental Engineering to determine need for respiratory and ventilation requirements.

a. **Mixing.** This primer is a two component air quality compliant material with a 340 g/l (2.8 lbs/gal) VOC content. Shelf life of unopened material is one year. Shake the base material for five minutes on a paint shaker and stir the catalyst with a wooden paddle prior to mixing. This is a two-

component primer which is mixed one volume of base to one volume of catalyst. Mix the material thoroughly following manufacturer's instructions after pouring the two components together. Do not mix more material than can be used in four hours.

b. **Thinning.** No thinning of this material is allowed for compliance with air quality regulation, application viscosity will be approximately 20 seconds in a #4 Ford Cup (23 seconds in #2 Zahn Cup).

c. **Application.** Prior to applying this primer, ensure the surface has been properly cleaned and treated in accordance with TO 1-1-691, as it will not adhere to an improperly prepared or contaminated surface. Apply one coat of primer to a dry film thickness of 1.0 to 1.5 mils (1.7 to 2.5 mils wet film). Allow a minimum of two hours air dry at 75°F and 50% relative humidity or four hours at 60°F and 50% relative humidity before application of topcoat. The coating must be applied in a relative humidity range of 30% to 80%. If humidity is below 30%, add moisture to the air wetting the floor of the painting area or by equivalent methods. If the primer is not topcoat within 24 hours, reactivate the primer surface by light sanding or scuffing with MIL-A-9962, Type I, Grade A abrasive mat. Discard any Class 2 primer mixed longer than four hours.



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Figure 3-10A. Minimum Drying Time for TT-P-2760, Type I, Class I

3-162. PRIMER COATING, ELASTOMERIC, POLYSULFIDE, CORROSION INHIBITING, MIL-P-87112 (USAF) (PR-1432GP).

**WARNING**

MIL-P -87112 (PR-1432GP) is moderately toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Consult Bioenvironmental Engineering to determine need for respiratory and ventilation requirements.

a. Mixing. This is a two-component material supplied in kit form consisting of a base compound and an accelerator in the proportions of 15 to one by weight. The material should always be properly mixed in the correct proportions by the manufacturers directions for optimum results.

**NOTE**

The base compound has a tendency to settle out in storage and should be thoroughly mixed prior to adding the accelerator.

(1) Shake the base compound on a standard paint shaker for five minutes.

(2) Mix the accelerator by stirring and add to the base compound.

(3) Replace the base compound container lid and shake for two to three minutes in an upright position followed by two to three minutes in an inverted position.

**NOTE**

Fast and longer mixing will decrease application time (pot life). High humidity (70% R.H. or above) at time of mixing will decrease application time (pot life).

b. Thinning. As supplied, this material is too viscous to be easily sprayed and must be thinned prior to application. Thinning of the material shall

be accomplished immediately after mixing of the two components. Transfer the mixed material to a pressure pot, thin 50% by volume with a MEK and Toluene blend, and mix in the pressure pot for 2 minutes at 70 RPM. Use the MEK/Toluene blend specified below for the following mixing and application temperatures. After thinning, the viscosity of the material shall be 8 to 22 seconds in a No. 4 Ford Cup (17-24 seconds in a No. 2 Zahn Cup).

(1) 75°F - 50% (by volume) MEK and 50% (by volume) Toluene.

(2) 85°F - 25% (by volume) MEK and 75% (by volume) Toluene.

(3) 65°F - 75% (by volume) MEK and 25% (by volume) Toluene.

c. Application. Application time (pot life) is based on standard conditions of 75°F temperature and 50 relative humidity. Application time at standard conditions is 1 1/2 hours. For every 18 °F rise in temperature, the application time is reduced by half; and for every 18 °F drop in temperature, the application time is doubled. Under standard conditions, the tack free time is approximately 6 hours; however, high humidity at time of application will shorten the tack free time. The polysulfide primer shall be applied to the entire aircraft exterior surface to a wet film thickness of 3.0 to 4.0 mils. This wet film thickness will result in a dry thickness of 1.0 to 1.2 mils. The material will cure to a tack free condition in 6 hours at 75°F and 50% relative humidity, 3 hours at 90°F, and 12 hours at 60°F. The polyurethane topcoat, MIL-C-83286 can be applied anytime after the polysulfide primer is tack free up to 24 hours if no moisture or dirt is on the aircraft, the aircraft is kept in an environmental controlled hangar and no maintenance or walking has been done on the aircraft.

**NOTE**

The material shall be applied to test panels as specified in paragraph 3-126, so that any defects can be corrected prior to production spray application. The correct line and pot pressure can be determined at this time.

## 3-163. POLYURETHANE TOPCOAT MIL-C-83286.

**WARNING**

- The catalyst portion of polyurethane topcoat contains a resin which may contain up to one percent hexamethylene diisocyanate (HMDI), this material is a sensitizing agent and in low atmospheric concentrations is a strong respiratory and skin irritant. After the catalyst portion containing hexamethylene diisocyanate is mixed with the polyester resin base component, the hexamethylene diisocyanate reacts chemically with the resin base and the potential for generation of hexamethylene diisocyanate is significantly reduced. Personnel mixing the isocyanate catalyst component with the polyester resin base component must avoid the vapors and skin contact of these materials. Mixing will be done in exhaust ventilated booth or well-ventilated area. Personnel will wear plastic or rubber gloves, plastic apron, and a face shield. Requirement for respiratory protection during mixture and application procedures should be determined by Bioenvironmental Engineering.
- Even after the polyurethane components have been mixed as noted above, painting with the polyurethane paint, Specification MIL-C-83286 and MIL-C-85285 still may result in a significant health hazard to the painter. Respiratory protection will be specified by the local medical service based upon the process evaluation by Bioenvironmental Engineering. Also, it is important that all the precautions required for spray painting as outlined in TO 42A-1-1 be rigidly enforced. Personnel with histories of allergies or asthma should be cleared through the base medical services before using any material containing diisocyanates.

**CAUTION**

Since the polyurethane is sensitive to moisture, ketones, and alcohols, use only clean, dry equipment for mixing and keep the mixed material in closed containers. Use adequate oil and water separators between the air supply and pressure pot to exclude water. Water will react with the catalyst and liberate carbon dioxide, causing bubbles and craters in freshly applied polyurethane paint. In addition, blow down air lines at least every hour to remove water. Reaction of catalyst with water is evident by accelerated increase in viscosity.

- a. Mixing. Thoroughly agitate the resin component (preferably with a mechanical shaker) and stir the catalyst with a wooden paddle in an exhaust ventilated booth or a well-ventilated area and pour into separate metering containers. Mix one part resin (Component I) to one part aliphatic isocyanate reactant catalyst (Component II) by volume, unless otherwise specified by the manufacturer, and agitate thoroughly. Allow to stand 30 minutes so that catalyst can start to react with the resin and air bubbles can escape. If in-line or in-head proportioning equipment is used to mix base and catalyst as the paint is being used, a 30 minute dwell time is not required before applying the coating. Cure accelerators are not authorized for use in painting aircraft exterior surfaces. The viscosity should be 10 to 16 seconds in a No. 4 Ford Cup (18-21 seconds in a No. 2 Zahn Cup), and if necessary can be adjusted with thinner MIL-T-81772, Type I. Use only catalyst and resin from the same manufacturer and do not mix more material than will be used in a 7-hour period. It is preferable, however, that the amount of material mixed at one time be limited to that usable in two hours. The gunship quality polyurethane coatings are required to be agitated continuously during spraying applications to prevent settlement of pigment and ensure uniformity of color.

Table 3-1A. Allowable Aerospace Coating Thickness for Production Level Finishing (Depot, Original Manufacture, Field)

COATING SPECIFICATION	NUMBER OF COATS	DRY FILM THICKNESS RANGE (INCHES)	
		MINIMUM (1)	MAXIMUM (1)
MIL-P-23377 and MIL-P-85582 Epoxy Primers	One	0.0006	0.0009
	To Be Reactivated (2)	0.0003	0.0005
	Mist, "Tie Coat" Activation	0.0003	0.0005
	After Reactivation, Total	0.0006	0.0010
	Two	0.0012	0.0018
TT-P-2760 Elastomeric Polyurethane Primer	One	0.0010	0.0015
MIL-C-83286 Polyurethane Coating	Two	0.0016	0.0024
	Three	0.0024	0.0036
MIL-C-85285 High Solids Polyurethane Coating	One Crosscoat	0.0016	0.0024
	Two Crosscoats	0.0032	0.0048
MIL-C-22750 Epoxy Topcoat	One	0.0008	0.0020
	Two	0.0016	0.0040
MIL-L-81352 Acrylic Lacquer	Two	0.0005	0.0015
MIL-C-27725 Fuel Tank Coating	Two	0.0008	0.0012

(1) Lower end of thickness range is expected when painting detail parts and small assemblies. Mid to high end of thickness range is often needed when finishing large areas such as the exterior of aircraft.

(2) A single coat which is to be reactivated with a mist, "tie coat" for topcoat application after scuffsanding.

b. Application. Apply two wet coats of polyurethane topcoat over the primer. Each coat shall have a 0.8 to 1.2 mil dry film thickness 2.0 to 3.0 mils wet film with a total topcoat dry film thickness of 1.6 to 2.4 mils. The total paint system (primer and topcoat) dry film thickness varies according to the type primer used. Drying time between topcoats shall be 30 minutes minimum and four hours maximum at 75°F and six hours maximum at 60°F.

(1) Gunship quality polyurethane paint is a special formulation, low reflectance, controlled source paint. (See TO 1-1-4, Section V, for approved sources.) This paint provides a finish with a gloss factor of three or less at both 60° and 85° angles of incidence when applied properly. Application procedures are the same as for standard polyurethane paint except certain procedures are important to assure the finish provides the gloss property built into the coating. Continues agitation or stirring of

the mixed and thinned coating is essential during the entire application process to keep a uniform dispersion of the pigment without settling. Heavy application of each coat should be avoided. Wrong nozzle size and too high an air pressure or fluid pressure at the gun can also affect the outcome of the gloss.

3-164. POLYURETHANE TOPCOAT, HIGH SOLIDS (MIL-C-85285) TYPE I. This coating is a two component high solids, polyurethane coating formulated for compliance with air quality regulations with a 420 g/l (3.5 lbs/gal) VOC content.

### WARNING

- The catalyst portion of polyurethane topcoat contains a resin which may contain up to one percent hexamethylene diisocyanate (HMDI), this material is a sensitizing agent and in low atmospheric concentrations is a strong respiratory and skin irritant. After the catalyst portion containing hexamethylene diisocyanate is mixed with the polyester resin base component, the hexamethylene diisocyanate reacts chemically with the resin base and the potential for generation of hexamethylene diisocyanate is significantly reduced. Personnel mixing the isocyanate catalyst component with the polyester resin base component must avoid the vapors and skin contact of these materials. Mixing will be done in exhaust ventilated booth or well ventilated area. Personnel will wear plastic or rubber gloves, plastic apron, and a face shield. Requirement for respiratory protection during mixture and application procedures should be determined by Bioenvironmental Engineering.
- Even after the polyurethane components have been mixed as noted above painting with the polyurethane paint, Specification MIL-C-83286 and MIL-C-85285 still may result in a significant health hazard to the painter. Respiratory protection will be specified by the local medical service based upon the process evaluation by Bioenvironmental Engineering. Also, it is important that all the precautions required for spray painting as outlined in TO 42A-1-1 be rigidly enforced. Personnel with histories of allergies or

asthma should be cleared through the base medical services before using any material containing diisocyanates.

### CAUTION

Since the polyurethane is sensitive to moisture, ketones, and alcohols, use only clean, dry equipment for mixing and keep the mixed material in closed containers. Use adequate oil and water separators between the air supply and pressure pot to exclude water. Water will react with the catalyst and liberate carbon dioxide, causing bubbles and craters in freshly applied polyurethane paint. In addition, blow down air lines at least every hour to remove water. Reaction of catalyst with water is evident by accelerated increase in viscosity.

a. **Mixing.** Thoroughly agitate the resin component (preferably with a mechanical shaker) and stir the catalyst with a wooden paddle in an exhaust ventilated booth or a well-ventilated area and pour into separate metering containers. Mix three parts resin (Component A) to one part catalyst (Component B) by volume, unless otherwise specified by the manufacturer, and agitate thoroughly. Induction time (dwell time) is not required before applying the coating. Use only catalyst and resin from the same manufacturer and do not mix more material than will be used in a 4-hour period. It is preferable, however, that the amount of material mixed at one time be limited to that usable in two hours. This polyurethane coating requires continuous agitation during spraying application to prevent settlement of pigment and ensure uniformity of color.

b. **Thinning.** Cure accelerators are not authorized for use in painting aircraft exterior surfaces as they change the cured properties and integrity of the coating. Cure retarders and thinners are not authorized for use with this coating as they are volatile organic compounds which will change the compliance of the coating to air quality regulations. The viscosity as mixed will be in the range of 8 to 29 seconds in a No. 4 Ford Cup (17 to 23 seconds in a No. 2 Zahn Cup), ready to spray.

c. **Application.** This product is to be applied over properly prepared and primed substrates. Aluminum surfaces shall be treated with a conversion coating conforming to MIL-C-5541, Class 1A, and primed with MIL-P-85582, Type I, Class 2; MIL-P-23377, Type I, Class 1 or 2; or TT-P-2760, Type I, Class 1 or 2. Steel surfaces shall be phosphate

treated or coated with MIL-C-8514 or DOD-P-15328 wash primer and primed with the same primers listed above. This product may be applied by conventional, airless, air assisted airless, high volume/low pressure or electrostatic equipment after proper mixing of the base and catalyst. Apply the coating in one wet cross-coats. The dry film thickness shall be 1.6 to 2.4 mils (2.7 to 4.0 mils wet film). Air assisted airless is preferable. For air assisted airless, use No. 617 tip for 12 inch fan and No. 517 tip for 10 inch fan and atomize at eight to ten psi at the tip with the trigger pulled.

3-165. CURING OF COMPLETE POLY-URETHANE SYSTEM. Cure schedule enumerated for polyurethane coatings shall be followed. Aircraft shall not be operated until 72 hours has elapsed at a temperature of 75°F or higher, after the topcoat application is completed. If the temperature is less than 75°F at anytime during the cure cycle, it is preferable to wait a full seven days before flying the aircraft.

a. Curing time before handing taping, masking etc., 6 hours minimum. Time may be reduced to 4 hours if temperature and humidity at upper limit (90°F and 80% RH). Low temperature and low humidity (60°F and 30% RH) retards cure rate to 12 hours minimum.

b. Curing time before movement from controlled hangar environment at a temperature of 75°F or higher is 6 hours minimum after application of last paint coat. Aircraft may then be moved to another location with a controlled environment of 75°F or higher to continue its 72 hour cure.

c. Curing time before decal application 8 hours, minimum.

d. Curing time before engine run up 30 hours, minimum.

e. Curing time before wet tape test 48 hours, minimum.

f. Curing time before flight 72 hours, minimum.

#### 3-166. MAINTENANCE PAINTING OF POLY-URETHANE SYSTEM.

3-167. Closely inspect candidate areas for extent of damage and/or maintenance painting required. If inspection reveals major paint failure or damage, such as chipped or peeled paint from the center of a skin panel, the involved skin section should be prepared and maintenance painted from seam to seam. If only minor damage is found, i.e., paint chipped or missing from screw/rivet heads and on outer edges of skin panel(s) the specific area may be prepared and maintenance painted. Prepare damaged area(s) and paint as follows:

a. Epoxy or Polyurethane Primer/Polyurethane Topcoat.

(1) Thoroughly clean area to be repainted.

(2) Feather edges of coating adjacent to peeled section and scuff sand the other area(s) to be coated. Use 180 grit paper or nylon abrasive matting material Specification MIL-A-9962 very fine or fine for scuff sanding. Grit size down to 120 may be used as long as care is taken not to score the metal surfaces.

(3) Wipe scuffed areas with enzyme cleaner, MIL-C-83873. Wipe scuffed areas with enzyme cleaner, MIL-C-83873.

<b>WARNING</b>
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- The catalyst portion of polyurethane topcoat contains a resin which may contain up to 1 percent hexamethylene diisocyanate (HMDI). This material is a sensitizing agent and in low atmospheric concentrations is a strong respiratory and skin irritant. After the catalyst portion containing hexamethylene diisocyanate is mixed with the polyester resin base component, the hexamethylene diisocyanate reacts chemically with the resin base and the potential for generation of hexamethylene diisocyanate is significantly reduced. Personnel mixing the isocyanate catalyst component with the polyester resin base component must avoid the vapors and skin contact of these materials. Mixing will be done in exhaust ventilated booth or well-ventilated area. Personnel will wear plastic or rubber gloves, plastic apron, and a face shield. Requirement for respiratory protection during mixture and application procedures should be determined by Bioenvironmental Engineering.

- Even after the polyurethane components have been mixed as noted above, painting with the polyurethane paint, Specification MIL-C-83286 and MIL-C-85285 still may result in a significant health hazard to the painter. Respiratory protection will be specified by the local medical service based upon the process evaluation by the Bioenvironmental Engineer. Also, it is important that all the precautions required for spray painting as outlined in TO 42A-1-1 be rigidly enforced. Personnel with histories of allergies or asthma should be cleared through the base medical services before using any material containing diisocyanates.

(4) Apply (brush or spray) one thin coat of epoxy primer Specification MIL-P-23377, MIL-P-85582, or Polyurethane Primer TT-P-2760 to the area being touched up. Thoroughly mix the primer material before use, however, the viscosity does not

need to be checked. See basic application instructions for guidance on mixing.

(5) Apply one full wet coat of thoroughly mixed polyurethane topcoat. If required, apply a second coat after allowing 1-4 hours curing period for the first coat.

b. Power Pak Spray Unit FSN 4940-00-803-6444, Specification MIL-S-22805, Type I, Class 22 (P/N M22805-1-22) may be a valuable aid in accomplishing field maintenance painting. (See Figure 3-23.) Kit is designed to be disposable and intended for use in isolated areas when air or electric spray guns cannot be used or are not available. The Director of Maintenance shall assure that utilization of this unit for maintenance painting purposes is held to the absolute minimum. Replacement Freon HCFC/Type 22 propellant cans may be obtained under Specification BB-F-1421, Type 22, NSN 6830-00-997-1430.

c. When polyurethane is not available, repair of present systems with MIL-C-85054, Type I, Class B CPC sprayed on or Type II brushed on bare metal areas for protection until polyurethane is available is permissible. Complete painting of aircraft with other than polyurethane MIL-C-83286, or MIL-C-85285, Type I, is not authorized.

3-168. Minimum Curing Time for Maintenance Painting of Polyurethane System: at 75° and 50% RH and higher: (Lower temperatures and relative humidity require longer cure times.)

a. Complete leading edges (All), complete control surface (All), major skin panels 9 square feet and over, and engine intake 72 Hours.

b. Skin panels less than 9 square feet, fasteners, rivet heads, screw heads, and minor chipped and scratched areas, less than 36 square inches 30 Hours.

### 3-169. ACRYLIC-NITROCELLULOSE LACQUER SYSTEM.

3-170. The acrylic-nitrocellulos lacquer coating system consists of metal pretreatment (wash primer), Specification MIL-P-7962, primer coating, cellulose nitrate, and an acrylicnitrocellulose topcoat conforming to either Specification MIL-L-19537 or MIL-L-19538.

3-171. COATING COMPOUND (WASH PRIMER), METAL PRETREATMENT, RESIN-ACID, SPECIFICATION MIL-C-8514.



Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies

TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
Sags and Runs	<ol style="list-style-type: none"> <li>1. Dirty air cap and fluid tip (distorted spray pattern).</li> <li>2. Gun stroked too close to the surface.</li> <li>3. Trigger not released at end of stroke (when stroke does not go beyond object).</li> <li>4. Gun stroked at wrong angle to surface.</li> <li>5. Coating material too cold.</li> <li>6. Coating piled on too heavy.</li> <li>7. Coating material thinned out too much.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove air cap and clean tip and air cap carefully.</li> <li>2. Maintain 6 to 10 inches distance from surface.</li> <li>3. Release the trigger after every stroke.</li> <li>4. Keep gun at right angle (perpendicular) to surface during stroke.</li> <li>5. Heat material by approved methods.</li> <li>6. Develop ability to apply correct thicknesses by panel practice.</li> <li>7. Add the correct amount of solvent by measure or determine by viscosity test.</li> </ol>
Streaks	<ol style="list-style-type: none"> <li>1. Dirty air cap and fluid tip (distorted spray pattern).</li> <li>2. Insufficient or incorrect overlapping of strokes.</li> <li>3. Gun stroked too rapidly (dusting of the paint).</li> <li>4. Gun stroked at wrong angle to surface.</li> <li>5. Stroking too far from surface.</li> <li>6. Too much air pressure.</li> <li>7. Split spray.</li> <li>8. Coating material too cold.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove air cap and clean tip and air cap carefully.</li> <li>2. Follow the previous stroke accurately. Deposit a wet coat.</li> <li>3. Avoid whipping. Make deliberate, slow strokes.</li> <li>4. Keep gun at right angle (perpendicular) to surface during stroke.</li> <li>5. Maintain 6 to 10 inches from surface.</li> <li>6. Use least air pressure necessary.</li> <li>7. Clean the fluid tip and air cap.</li> <li>8. Heat material to get good flow-out.</li> </ol>
Paint will not come from Spray Gun	<ol style="list-style-type: none"> <li>1. Out of paint (gun begins to sputter).</li> <li>2. Settled, caked pigment blocking gun tip.</li> <li>3. Grit, dirt, paint skins, etc, blocking gun tip, fluid valve or strainer.</li> </ol>	<ol style="list-style-type: none"> <li>1. Add paint, correctly thinned out and strained.</li> <li>2. Remove obstruction, stir paint thoroughly.</li> <li>3. Clean spray gun thoroughly and strain the coating material. Always strain materials before using.</li> </ol>
Paint will not come from Pressure Tank	<ol style="list-style-type: none"> <li>1. Lack of proper air pressure in the pressure tank.</li> <li>2. Air Intake opening inside of pressure tank lid, clogged by dried-up material.</li> <li>3. Leaking gaskets on tank cover.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check for leaks or lack of air entry.</li> <li>2. This is a common trouble. Clean the opening periodically.</li> <li>3. Replace with a new gasket.</li> </ol>
Paint will not come from Suction Cup	<ol style="list-style-type: none"> <li>1. Dirty fluid tip and air cap.</li> <li>2. Clogged air vent on cup cover.</li> <li>3. Using wrong air cap.</li> <li>4. Leaky connections on fluid tube or nozzle.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove air cap and clean tip and air cap carefully.</li> <li>2. Remove the obstruction.</li> <li>3. Ascertain and use correct set-up.</li> <li>4. Check for leaks under water and repair.</li> </ol>

Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies (Cont)

TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
Excessive Material Loss	<ol style="list-style-type: none"> <li>1. Not triggering the gun at each stroke.</li> <li>2. Stroking at wrong angle to surface.</li> <li>3. Stroking gun too far from the surface.</li> <li>4. Wrong air cap or fluid tip.</li> <li>5. Depositing a film of Irregular thickness.</li> <li>6. Air pressure too high.</li> <li>7. Fluid pressure too high.</li> <li>8. Coating material too cold.</li> </ol>	<ol style="list-style-type: none"> <li>1. It should be a habit to release trigger after every stroke.</li> <li>2. Gun should be stroked at right angles to surface.</li> <li>3. Stroke the gun 6 to 10 inches from the surface.</li> <li>4. Ascertain and use correct set-up.</li> <li>5. Learn to calculate the depth of wet film of finish and develop control.</li> <li>6. Use the least amount of air necessary.</li> <li>7. Reduce pressure. If pressure keeps climbing, clean regulator on pressure tank.</li> <li>8. Heat to enable reduced air pressure.</li> </ol>
Excessive Spray Fog (Figure 3-11)	<ol style="list-style-type: none"> <li>1. Too high air pressure.</li> <li>2. Spraying past surface of the product.</li> <li>3. Wrong air cap or fluid up.</li> <li>4. Gun stroked too far from the surface.</li> <li>5. Material thinned out too much.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use least amount of air pressure necessary</li> <li>2. Release trigger when, gun passes target.</li> <li>3. Ascertain and use correct setup.</li> <li>4. Stroke the gun 6 to 10 inches from surface.</li> <li>5. Add the correct amount of solvent by measure or test.</li> </ol>
Paint Leaks from Spray Gun (Figure 3-12)	<ol style="list-style-type: none"> <li>1. Fluid needle packing nut too tight.</li> <li>2. Packing for fluid needle dry.</li> <li>3. Foreign particle blocks fluid tip.</li> <li>4. Damaged fluid tip or needle.</li> </ol>	<ol style="list-style-type: none"> <li>1. Loosen nut, lubricate packing.</li> <li>2. Lubricate this part daily.</li> <li>3. Remove tip and clean.</li> <li>4. Replace both tip and needle.</li> </ol>
Gun Sputters Constantly (Figure 3-13)	<ol style="list-style-type: none"> <li>1. Fluid nozzle not tightened to the spray gun.</li> <li>2. Leaking connection of fluid tube or needle packing (suction cup).</li> <li>3. Fluid pipe not tightened to the pressure tank lid.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten securely, using a good gasket.</li> <li>2. Tighten connections; lubricate packing.</li> <li>3. Tighten. Check for defective threads.</li> </ol>
Orange peel (Figure 3-14)	<ol style="list-style-type: none"> <li>1. Coating material not thinned out sufficiently.</li> <li>2. Coating material too cold.</li> <li>3. Not depositing a wet coat.</li> <li>4. Gun stroked too rapidly (dusting the paint).</li> <li>5. Insufficient air pressure.</li> <li>6. Using wrong air cap or fluid nozzle.</li> <li>7. Gun stroked too far from the surface.</li> <li>8. Overspray striking a previously sprayed surface.</li> </ol>	<ol style="list-style-type: none"> <li>1. Add the correct amount of solvent by measure or viscosity test.</li> <li>2. Heat material to get flow-out.</li> <li>3. Check solvent. Use correct speed and overlap of stroke.</li> <li>4. Avoid whipping. Take deliberate, slow strokes.</li> <li>5. Increase air pressure or reduce fluid pressure.</li> <li>6. Select correct air cap and nozzle for the material and feed.</li> <li>7. Stroke the gun 6 to 10 inches from surface.</li> <li>8. Spray detail parts first. End with a wet coat.</li> </ol>

Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies (Cont)

TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
Sandpaper Finish (Figure 3-15)	<ol style="list-style-type: none"> <li>1. Unsatisfactory wash primer or primer.</li> <li>2. Excessive dirt contamination from painting area.</li> <li>3. Insufficient scuff-sanding of wash primer or primer.</li> <li>4. Improperly cleaned paint lines.</li> <li>5. Dried overspray.</li> </ol>	<ol style="list-style-type: none"> <li>1. Laboratory analysis to verify acceptability of the material; check wash primer and primer application procedures.</li> <li>2. Provide cleaner painting areas.</li> <li>3. Scuff-sand wash primer using No. 320 and No. 400 wet-or-dry sandpaper.</li> <li>4. Flush paint lines frequently with solvent.</li> <li>5. Sand the complete finish until smooth to the fingertips.</li> </ol>
Wrinkling (Figure 3-16)	<p>Caused by applying too thick a coating, this prevents uniform drying of the coat and thus results in formation of ridges and furrows.</p>	<p>Material should be applied in thin uniform coats. If a thick coating is necessary, it should be applied by spraying several thin coats until the desired thickness is obtained. Allow each coat to set before applying the next.</p>
Crazing, Crackling, Checking (Figures 3-17 and 3-18)	<ol style="list-style-type: none"> <li>1. Painting over a hard glossy coat. A base coat of this condition offers a poor surface adhesion of subsequent coats. In drying, the topcoat slides over the base coat, breaking out in cracks.</li> <li>2. Excessive amount of drier in paint causing brittleness.</li> <li>3. Excessive heat employed in drying operation.</li> <li>4. Insufficient drying times between coats.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove all previous coats of paint using paint remover.</li> <li>2. Drier should be used only as recommended by manufacturer of material being used.</li> <li>3. Exercise caution in placement of heat lamps to assure uniform heat distribution over the entire painted area.</li> </ol>
Slow Drying of Wasii Primer	<p>Accidental addition of Federal Specification TT-T-266 thinner; excessive butyl alcohol addition; high humidity conditions, excessive thickness; denaturants in the alcohol such as oils, high boilers, etc, introduced by the accidental use of the wrong alcohol.</p>	<p>Check mix, using smaller quantities of same batch, apply to test panel; modify quantity of thinner added and compare drying times under actual painting conditions; incorporate use of small test panel adjacent to all aircraft during complete painting procedure, using such panel for thickness measurements also.</p>

Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies (Cont)

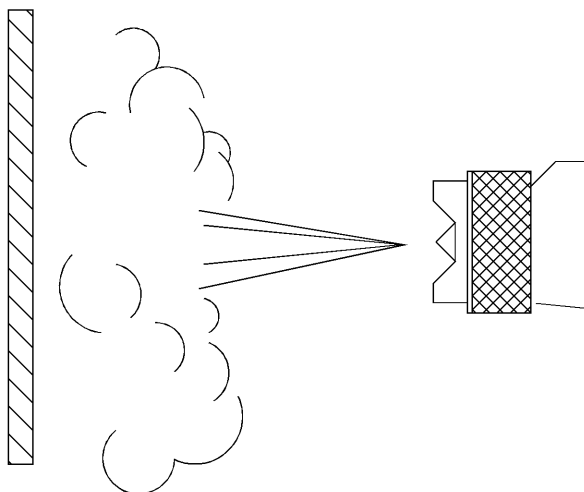
TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
Pinhole Cavities	Improper surface treatment or lack of surface treatment (on magnesium); entrapped oils and/or solvents; insufficient primer drying times; excessive alcohol additions to wash primer; use of improper thinner.	Apply manual surface treatment and insure complete coverage of the magnesium with surface chemical film, before wash primer application; microscopic examination of stripped paint removed during tape test; check mixing instructions to eliminate use of improper thinners.
Excessive Blushing of Topcoats.	Excessive humidity; insufficient quantity of Specification MIL-T-6095 blush-retardant thinner or Federal Specification TT-E-776.	Check humidity control equipment where employed and/or increase quantity of Specification MIL-T-6095 thinner or Federal Specification TT-E-776.
Dry Lacquer Film	High temperature and low humidity while spraying.	Add Specification MIL-T-6095 blush-retardant or Federal Specification TT-E-776.
Peeling	Failure to remove moisture, oil or grease from the surface before the finish is applied.	Refinish surface.
Bubbles	1. A too heavy coat of lacquer applied over a doped surface. 2. Doped surface not thoroughly dried before application of lacquer.	Wash surface with dope thinner until smooth; allow surface to dry 10 to 12 hours (preferably overnight) sand and apply lacquer in thin coats.
Blisters (on Fabric)	Dope on inner surface of fabric resulting from excessive brushing, seepage through openings, etc.	Cut the fabric around the blister, apply a patch and refinish.
Blistering (Figure 3-19)	1. Oil or grease on surface. 2. Moisture in lines. 3. Trapped solvents.	1. Strip and clean; or sand down and repaint. 2. Drain lines periodically. 3. Use proper thinner.
Inconsistent Coloring	Pigment not evenly distributed as a result of settling or insufficient mixing.	Apply additional coats after thoroughly mixing the finish material.
Brittleness (on Fabric)	1. Fabric applied too tightly. 2. Aging of doped surface.	Apply acetone with brush or rag. Apply 50 percent solution of fast-evaporating solvent and dope over the brittle surface to revive the finish; if this treatment is not effective, the structure must be recovered.
Defective Spray Patterns (Heavy Center)	1. Setting too low on spreader adjustment 2. Twin-jet cap; atomizing pressure too low. 3. Pressure feed: Fluid pressure too high for normal capacity of cap. 4. Nozzle too large for fluid used.	1. Adjust spreader adjusting valve. 2. Adjust atomizing pressure. 3. Adjust fluid pressure. 4. Replace nozzle with correct size.

Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies (Cont)

TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
Defective Spray Patterns (Split Spray)	Air and fluid feeds not properly balanced.	Reduce width of spray pattern by means of the spreader adjusting valve and, if condition is not remedied, increase fluid pressure. The latter increases rate of material flow. Readjust atomizing pressure, fluid pressure, and spray width until desired spray is obtained.
Defective Spray Patterns (Heavy Top or Bottom) (Heavy Right or Left)	<ol style="list-style-type: none"> <li>1. Horn holes partially clogged. Obstruction on top or bottom side of nozzle.</li> <li>2. Dirt on air-cap seat or nozzle fluidtip seat.</li> </ol>	<ol style="list-style-type: none"> <li>1. Determine location of obstruction by rotating air cap one-half turn and spray a new pattern. defect is reversed, obstruction is in air cap; if not reversed, it is on the nozzle of fluid tip.</li> <li>2. Clean. Check for burrs and dried paint in opening.</li> </ol>
Starving the Spray Gun	<ol style="list-style-type: none"> <li>1. Insufficient air because of waste filter in transformer too tightly packed or clogged.</li> <li>2. Aircocks, hose or pipelines too small.</li> <li>3. Inadequate air supply from too small a compressor or a break in the system.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repack or replace filter.</li> <li>2. Replace with units of adequate size.</li> <li>3. Obtain a compressor of adequate size or repair leakage.</li> </ol>
Wet Areas	<p>This is an indication that oil, grease, wax, soap, etc, which may have been on the surface previous to lacquering or doping, had not been properly removed.</p>	Clean all surfaces thoroughly with approved type cleaners.
Failure of Wet Tape Test.	<p>Insufficient drying time on wash primer and/or zinc chromate primer; insufficiently cleaned aluminum surface; cleaning compound residue, etc. Oil seepage throughout inspection doors and blind rivets (especially jet aircraft); entrapped oils and soil in zinc chromate shop primer; excessively aged zinc chromate primer; insufficient removal of shop primer and/or previous coatings; use of final finishes incorporating wax ingredients; use of laundered rags instead of new mill ends; use of water-sensitive zinc chromate primer not conforming to specification requirements; seepage of water containing cleaning compound residues from between fraying surfaces.</p>	<p>Employ initial wipedown, using safety solvent followed by lacquer thinner as an auxiliary cleaner; remove a shop primers to provide a clean aluminum surface prior to any painting; primer shop coat elimination preferred as oil removal from shop primer coats practically impossible; employ solvent-dampened cloths in lieu of dry cloths for removal of oil contamination (especially along jet engine inspection doors); conduct laboratory analysis to determine primer acceptability; delay wax application for 30 days after final paint application to avoid need for use of solvents by receiving activity or squadron to remove wax; allow aircraft to stand for sufficient time to permit drainage of effluent before final cleaning; note the type of failure, such as to bare metal intercoat failure, and select the applicable cause a remedy accordingly.</p>

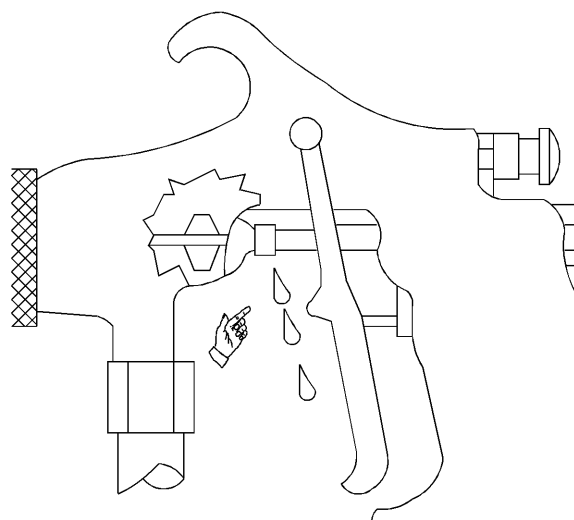
Table 3-2. Spray Coating Troubles, Possible Causes, and Remedies (Cont)

TROUBLE	POSSIBLE CAUSES	PREVENTIVE MEASURES OR REMEDIES
<p>Fish-Eyes and Poor Wetting, Crawling, Poor Flowout. (Figure 3-20)</p> <p>Lifting (Figure 3-21)</p> <p>Pitting or Cupping (Figure 3-22)</p>	<p>Use of waxes or sealants and adhesives containing silicones.</p> <p>NOTE: Minute quantities of silicones can cause this difficulty.</p> <ol style="list-style-type: none"> <li>1. Absorption of solvents by previous partially dried film.</li> <li>2. Second coats apt to lift if poorly prepared surface.</li> <li>3. Use of lacquer over enamel.</li> <li>4. Use of lacquer thinner in enamel.</li> </ol> <ol style="list-style-type: none"> <li>1. Rust under surface.</li> <li>2. Oil or grease on surface.</li> <li>3. Moisture in lines.</li> <li>4. Trapped solvents.</li> </ol>	<p>Solvent clean with silicone-removing compounds.</p> <ol style="list-style-type: none"> <li>1. Allow coats to dry before recoating with lacquers; with enamels either allow first coats to dry completely, or apply second coats immediately.</li> <li>2. Begin with properly prepared surface.</li> <li>3. Use compatible coatings and thinners.</li> </ol> <ol style="list-style-type: none"> <li>1. Drain lines periodically.</li> <li>2. Use proper thinner proportions.</li> <li>3. Strip and clean; or sand down and repaint.</li> </ol>



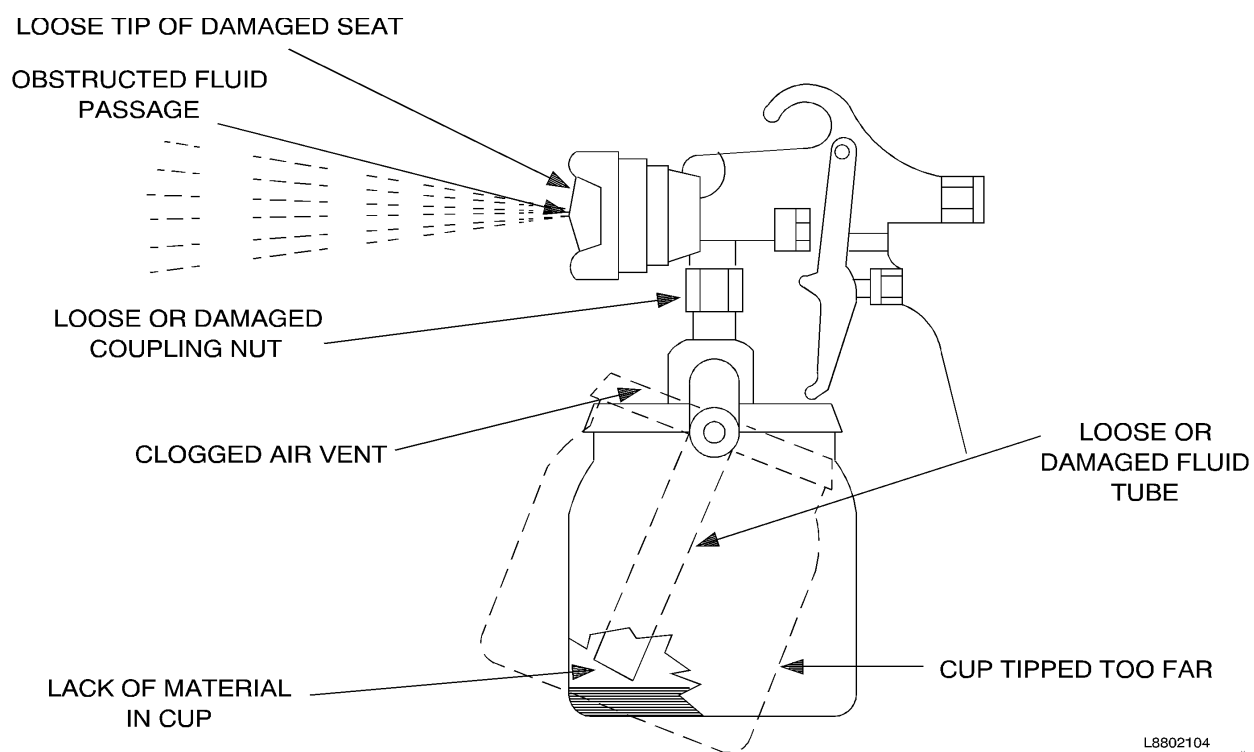
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Figure 3-11. Excessive Spray Fog



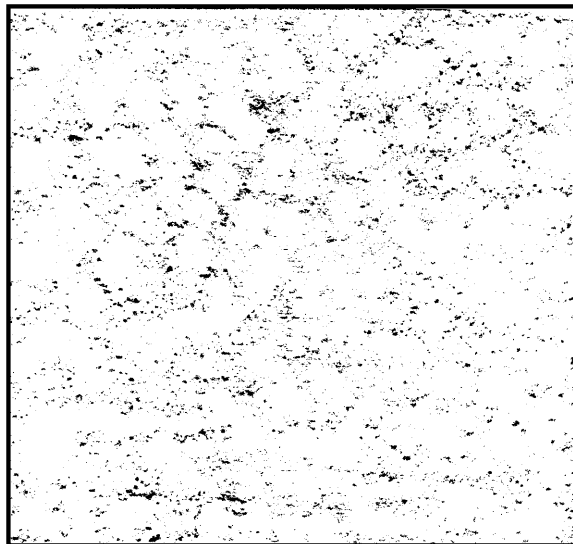
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Figure 3-12. Paint Leaks From Spray Gun



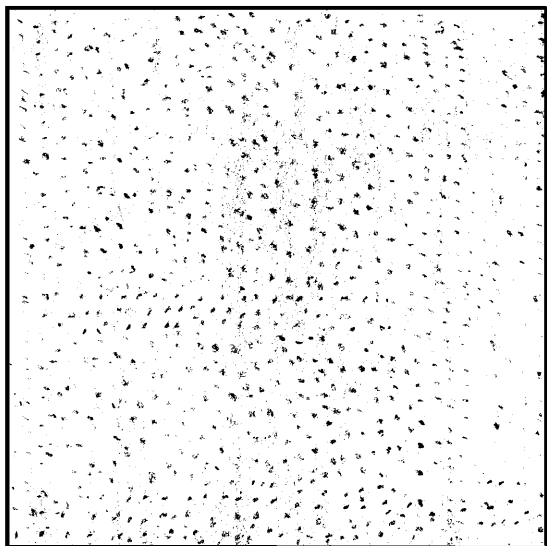
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Figure 3-13. Gun Sputters Constantly



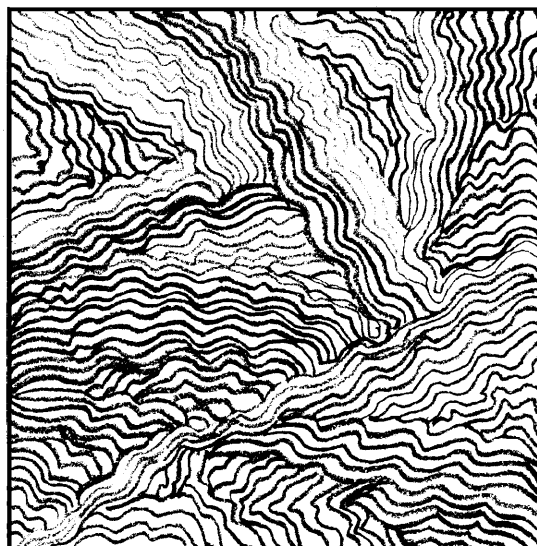
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*Figure 3-14. Orange Peel*



L9401038

*Figure 3-15. Sandpaper Finish*



L9401039

*Figure 3-16. Wrinkling*



*Figure 3-17. Crazing*

*Figure 3-18. Checking*

*Figure 3-19. Blistering*

*Figure 3-20. Fish Eyes and Poor Wetting, Crawling, Poor Flowout*

*Figure 3-21. Lifting*

*Figure 3-22. Pitting or Cupping*



Figure 3-23. Power Pak Spray Unit

3-172. This coating is furnished with a resin component and an acid component which are mixed just prior to use. The resin component consists of an insoluble zinc chromate and magnesium-silicate in a polyvinyl-butyral resin and alcohol vehicle. The acid component is phosphoric acid, ethyl alcohol, butyl alcohol, and water. The primary purpose for wash primer is as a tie coat between the base metal (with or without conversion coating) and the subsequently applied primer coat. It will not provide lasting protection.

#### NOTE

Do not use wash primer over one year old without first checking its quality.

#### 3-173. MIXING.

a. Thoroughly mix each of the two components using a mechanical shaker or approved equivalent to reincorporate any settled portion. Slowly add one part (by volume) acid component in small portions to four parts resin component with constant stirring. Never add the resin component to the acid component.

#### WARNING

MIL-C-8514 is flammable and moderately toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

#### NOTE

The acid component is not a thinner but a necessary activator. Do not vary the ratio of acid to resin. Too little acid content in the wash primer will result in poor coating adhesion and an excess of acid will cause serious brittleness.

b. The pigment portion of the resin component may settle and develop a hard cake during prolonged storage. When this condition is encountered, pour the top liquid into a separate container and break the hard cake with a paddle. Gradually add the poured-off liquid in small amounts with continuous stirring until the cake is reincorporated.

3-174. Pot Life. Polymerization starts immediately when the acid and resin component are mixed, restricting the pot life of the wash primer. If the temperature is below 90°F, mix only the amount of wash primer which will be used in a 4-hour period. Limit the quantity to a 2-hour supply if the temperature exceed 90°F.

3-175. Thinning for Spraying. To spray uniformly thin films of wash primer and to lessen cobwebbing, the wash primer normally requires thinning with ethyl alcohol conforming to Specification MIL-A-6091. The correct spraying viscosity is 24 to 31 seconds on a No. 2 Zahn Cup. Some wash primer material may appear to be suitable for spraying without thinning and can actually be sprayed without apparent difficulty. However, the end result is usually a rough appearance which will be transmitted through the topcoat, necessitating hand rubbing to give satisfactory appearance. Also, it will be more difficult to obtain the correct uniform dry film thickness.

a. Normal Weather Conditions. Under normal weather conditions (35 to 70 percent relative humidity and 50°F to 90°F) thin with ethyl alcohol or mixture of 90 parts ethyl alcohol to 10 parts butyl alcohol conforming to Specification TT-B-846. A volume of diluent (thinner) equal to the volume of acid component is generally sufficient to obtain a wash primer of adequate spraying viscosity. Use the ethyl-butyl alcohol mixture diluent only during the high humidity-high temperature condition

within the normal weather range since butyl alcohol increase the drying time.

b. Low-Humidity Conditions. Under low-humidity conditions (less than 35 percent relative humidity) and moderate temperatures (70°F to 80°F) prevalent in heated areas during winter months, the normal dilution specified above will result in poor intercoat and system adhesion of subsequently applied topcoats. This difficulty may be minimized by thinning with one part by volume of diluent to five parts by volume wash primer. Use diluent composed of two parts (by volume) of distilled or demineralized water and one part (by volume) of a 90:10 ethyl alcohol: butyl alcohol mixture. The above diluent composition is given only as a starting point and should be modified where local conditions warrant. Table 3-3 shows the amount of each component generally necessary to furnish a satisfactory wash primer.

c. High Humidity Conditions. Blushing of the reduced wash primer may occur under high-humidity conditions (approximately 70 percent relative humidity or more). Subsequently, applied topcoatings will not adhere to blushed films. Blushing may frequently be eliminated by adding to or substituting for the higher evaporation rate solvent such as ethyl alcohol, a lower evaporation rate blush-retardant solvent, such as diactone alcohol, Federal Specification O-D-306, or butyl alcohol, Federal Specification TT-B-846. The diactone alcohol evaporates slowest and offers maximum blush resistance.

**NOTE**

Do not use lacquer thinner, Specification MIL-T-19544, to reduce wash primer since such addition will increase the drying of the wash primer and, in

case of high humidity, may prevent drying of the wash primer for a period of several days.

3-176. Film Thickness. The proper dry film thickness is 0.2 to 0.3 mil. A wet film thickness of 0.6 mil will give a dry film thickness of 0.2 to 0.3 mil. The wet film thickness may be measured with a Nordsen Wet Film Thickness Gage or similar gauge.

**NOTE**

To control thickness, place small panel(s) adjacent to the item being coated. Measure the film thickness on the test panel to assure proper wash primer thickness.

3-177. Application of Wash Primer. The wash primer may be applied by spraying, brushing, roller coating, or swabbing on a clean metal surface. Spray the wash primer as a thin film so that a continuous film may be obtained. A single pass with the spray gun held 10 to 12 inches from the surface should provide a 0.2 to 0.3 mil thick dry film. Do not attempt to get a full hiding coat as this indicates an excessively thick coating. A coating which is too thick is undesirable because of poor adhesion of subsequent coatings due to entrapped alcohol in the wash primer and because of the added weight of the wash primer when weight is critical. Immediately remove thick coatings with alcohol and reapply the coating properly. Do not attempt to obtain a thin film by holding the spray gun more than 12 inches from the surface. Holding the gun more than 12 inches from the surface will result in a dry, powdery film deposit that will seriously impair the adhesion of the finish system.

Table 3-3. Thinning Ratio (Volume)

COMPONENT	QUANTITY	QUANTITY	QUANTITY
Resin	4 gallons	1 gallon	4/5 gallon
Acid	1 gallon	1 quart	1/5 gallon
Distilled Water	85 ounces	21 ounces	17 ounces
Ethyl Alcohol	39 ounces	10 ounces	1 ounce
Butyl Alcohol	4 ounces	1 ounce	1 ounce

**NOTE**

Applying over oil residues may result in a shiny appearance in the dried wash primer. Strip, reclean and recoat such areas.

a. Low-Humidity Application. Wash primer applied under low humidity (less than 35 percent)

will produce a generally good resistance to finger-nail scratches. However, adhesion of subsequently applied primers or topcoats to the wash primer will be poor. Frequently check the temperatures and relative humidity and stop work when low relative humidity conditions are encountered. If the relative humidity in the paint area cannot be raised, discard or set aside the wash primer being used and mix a

new batch following the instructions given in paragraphs 3-178, 3-179, and 3-180.

#### NOTE

Amendment 1 of Specification MIL-C-8514A, dated 21 March 1963, deletes approval to substitute isopropyl alcohol for ethyl alcohol. If the wash primer used contains isopropyl alcohol, the addition of water will cause the material to gel.

b. **High-Humidity Application.** Wash primer will blush, as evidenced by a whitish color (moisture condensation in the film) and by the ease with which it can be scratched with a fingernail, when applied under high relative humidity high temperature conditions. The degree of blushing may be judged by the ease of removal with a fingernail and by the color (severely blushed film is white). The degree of blushing may also be checked by determining the number of strokes necessary to remove the coating film, using a cloth saturated with thinner conforming to Federal Specification TT-T-266. Five to ten strokes under two pounds pressure will remove a severely blushed film, whereas 25 strokes will not remove an unblushed film. Completely wetting a blushed film surface by spraying with butyl alcohol within 8 hours after application will normally redeposit the film in an unblushed condition. When blushing is encountered, discard or set aside the wash primer being used and mix a new batch following instructions in paragraphs 3-178, 3-179, and 3-180.

3-178. **DRYING TIME.** Wash primer coating dries to handle within a few minutes. However, allow the primer to dry for at least 60 minutes but no more than 4 hours, depending on local temperatures and humidity condition before topcoating. For best results, apply the subsequent primer coat as soon after the wash primer passes the tape test (Section III, paragraph 3-144) because intercoat adhesion begins to degrade slowly on aging indoors and markedly when exposed to the sun. Best intercoat adhesion will generally be obtained after 1 to 2 hours drying. The actual drying time required can be determined for local conditions by applying wash primer to several test panels and applying the tape test after various drying periods. This can be done prior to or during wash primer application to the end item.

#### NOTE

Do not topcoat any wash primer when it has dried for more than 4 hours. Remove aged wash primer, thoroughly clean metal, and apply new wash primer coating.

#### WARNING

MIL-P-7962 is flammable and slightly toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

3-179. **Sanding of Wash Primer Coating Prior to Application of Specification MIL-P-7962.** To obtain the full gloss of exterior topcoat, dry scuff lightly with No. 320 or No. 400 abrasive paper to remove overspray and smooth out nibs. Remove dust resulting from this operation with a tack rag before applying the primer. New clean Kraft paper may be used for scuffing.

3-180. **PRIMER COATING, CELLULOSE-NITRATE MODIFIED ALKYD TYPE, CORROSION INHIBITING, FAST DRYING, SPECIFICATION MIL-P-7962.**

3-181. This is one grade of a corrosion-inhibiting fast-drying spray type lacquer primer for use over pretreatment coating (wash primer). It is a zinc chromate type primer modified to be compatible with nitrocellulose and acrylic nitrocellulose lacquer topcoats.

#### NOTE

Do not use primer over 2 years old without first checking to ensure it meets specification requirements.

3-182. **Mixing and Thinning for Spraying.** Thoroughly stir the primer and check to ensure that all the pigment is mixed and none remains on the bottom of the container. Thin to the proper spraying viscosity, 15 to 23 seconds through a No. 2 Zahn Cup, with thinner conforming to Federal Specification TT-T-266. Two volumes of primer to three volumes thinner will normally give the desired viscosity. Strain through fine mesh cloth before pouring into spray equipment.

#### NOTE

To alleviate blushing under high humidity conditions, replace up to 6 percent thinner by volume with ethylene glycol monobutyl (Specification MIL-T-6095).

3-183. **Film Thickness.** The proper dry film thickness is 0.3 to 0.4 mil which is equal to a wet film thickness of 0.6 to 0.8 mil.

3-184. **Application of Primer Coating.** Apply primer, using standard spray equipment and techniques. The primer may be applied by brush to very

small touch-up areas only since the material dries rapidly. The primer is capable of being applied by the hot airless spray method. One set of conditions found satisfactory for material with a viscosity of 20 seconds through a No. 2 Zahn Cup is 155°F at 650 psi gauge using a Nordson gun with an inner orifice of 0.015 inch and spray gun tip 09C09. Apply a thin coat which will give a film with a greenish-yellow cast. A heavy hiding coat of full yellow is not desired and will impair the performance of this lacquer primer.

3-185. **Drying Time.** The primer will normally dry to touch in 6 minutes. Apply the topcoat within 1 hour to obtain maximum intercoat adhesion. Carefully observe the topcoating for film lifting (caused by the highly solvent thinners in the acrylic nitrocellulose lacquer) and, if film lifting occurs, strip affected area and reapply the complete system.

3-186. **TOPCOAT, ACRYLIC NITROCELLULOSE LACQUER (MIL-L-19537 OR MIL-L-19538).**

3-187. When properly applied, this lacquer coating will have a service life of about 2 years on aircraft subject to severe corrosive environments. Fastener and similar areas where the paint system must bridge a gap should be checked frequently and touched up when the cracking is observed.

3-188. **Mixing and Application of Topcoat**

a. Reduce the packaged material to a spraying viscosity of 21/27 seconds through a No. 2 Zahn Cup with thinner, Specification MIL-T-81772, Types I, II, or III. A mixture of equal parts by volume of thinner with lacquer will normally provide the desired viscosity. Blushing will normally not occur even under relative high humidity because of the high boiling solvent used in Specification MIL-T-81772 thinner. However, if blushing does occur, replace a small amount of Specification MIL-T-81772 thinner with retarder, Federal Specification TT-E-776. Use only enough retarder to prevent blushing since sagging may result and more time for drying is necessary. Thinners TT-T-266 and CID A-A-857 may also be used; however, they are not blush-retardant thinner. The prevention of blush with these thinners is detailed in paragraph 3-118.

b. Apply two full wet coats (each coat dry film thickness of 0.4 to 0.5 mil) of acrylic nitrocellulose lacquer, Specification MIL-L-19537 or MIL-L-19538. Each coat consists of one double or cross pass of the gun. Allow at least 45 minutes drying time between coats. The second coat may be applied up to 96 hours later provided the first coat is suitably cleaned and light scuff-sanded to assure adequate adhesion of the second coat. The first coat

must be wiped down with solvent if an overnight delay or longer is encountered in the painting sequence. Do not apply masking tape for at least 2 hours. Allow to dry at least 48 hours before operating engines. Allow to cure 72 hours prior to flight.

c. When using aluminized MIL-L-19537, apply one mist coat approximately not to exceed 0.4 mils wet. Follow with two full wet coats each not to exceed 0.4 to 0.7 mils wet.

3-189. **Touch-Up.** Using the acrylic nitrocellulose lacquer or nitrocellulose lacquer system, touch-up damaged areas as follows:

a. Step 1. Thoroughly clean the area to be repainted of all grease, oil, dirt, and other surface contamination.

b. Step 2. Taper (feather) edges of adjacent finish and scuff the area to be coated.

c. Step 3. Where bare metal is exposed, apply wash primer, Specification MIL-C-8514 (refer to paragraph 3-176).

#### NOTE

Chemical conversion coating, Specification MIL-C-5541, may be used under the wash primer but is not considered necessary for touch-up.

d. Step 4. Apply one coat of lacquer primer, Specification MIL-P-7962, followed by one or two coats of acrylic nitrocellulose topcoat, Specification MIL-L-19537, MIL-L-19538, or nitrocellulose lacquer, Specification TT-1-32.

#### CAUTION

Do not use zinc chromate primer, Specification MIL-P-8585, since this will result in premature coating failure.

#### NOTE

To increase adhesion, apply a mist coat of thinner, Specification MIL-T-81772 to the damaged area before applying the first coat of acrylic nitrocellulose lacquer.

e. **Compatibility.** The acrylic nitrocellulose lacquer should not be used to touch-up nitrocellulose lacquer, Specification TT-L-32. Only MIL-L-19537 or MIL-L-19538 may be used for touch-up of acrylic nitrocellulose lacquers. Polyurethane, MIL-C-83286 shall not be used to touch-up Specification TT-L-32, MIL-L-19537 or MIL-L-19538.

3-190. **AIRCRAFT WALKWAY COATING, SPECIFICATION MIL-W-5044.**

3-191. Nonslip coatings are used to provide better footing on aircraft walkway surfaces and to protect the metal substrate from physical damage. These materials may also be used on vehicles, maintenance ramps, steps, ladders and similar areas. Non-skid coatings furnished under Specification MIL-W-5044, have peculiar features.

a. Type I. Type I is a smooth coating (formulated primarily for brush application) used along leading edges (aircraft flying less than 250 mph) and adjacent surfaces of aircraft where the roughness of Type II coating is undesirable because of aerodynamic considerations.

b. Type II. Type II is a rough material (formulated primarily for brush application) containing grit as an integral part of the coating. This material is used along trailing edges and adjacent surfaces in cases where maximum nonslip qualities are essential.

3-192. Mixing and Application of Walkway Coatings. Walkway coatings are applied to primed surfaces, prior to application of final topcoat of aircraft coating systems. The topcoat applied over walkway coating shall be a single mist to reduce distinctive difference in color and to minimize loss of nonslip features. Only Type II (rough) coating should be used under an aircraft coating system topcoat. Type II walkway coating need not be topcoated with the viathane exterior finish on interior walkways, ramps, steps, and doorways in high traffic areas. Before applying the nonslip coating, wipe prime surface with a clean lint-free cloth moistened with naphtha, methyl ethyl ketone or other suitable solvents, if necessary. Thoroughly mix the material, preferably with a mechanical shaker. The coating will normally be of the proper viscosity for brush or spray application. If thinning is necessary, use the specification solvent recommended by the manufacturer. Application by brushing is recommended as the material is primarily formulated for brushing. Apply quickly and avoid as much as possible brushing previously coated areas which are wet. Allow to dry at least 15 minutes but not more than 30 minutes between coats. Spraying should be avoided except when large areas are involved. Adjust the viscosity of the coating, if necessary, to 21 to 27 seconds on a No. 2 Zahn Cup. A Binks No. 19 spray gun with tank pressures of 10 to 15 psi and atomization pressure of 50 to 60 psi or a DeVilbiss MBC gun with a line air pressure of 30 psi and a cup pressure of 8 psi are suggested. The spray gun should be held comparatively close (6 to 8 inches) to the surface.

3-193. Film Thickness. The service life of a walking coating is largely dependent on the coating

thickness. The correct weight (dry) for aircraft use is 15 to 20 ounces per square yard for a smooth coating, and 20 to 25 ounces per square yard for the rough coating. This is equivalent to approximately 10 to 12 mils dry film thickness. A 30 to 40 mil thick coating is recommended for non-aeronautical application.

3-194. ELASTOMER RAIN EROSION RESISTANT COATING SYSTEMS, SPECIFICATION MIL-C-83231 AND MIL-C-83445.

3-195. These systems are elastomeric rain erosion resistance coatings used to protect exterior aircraft and missile plastic parts, such as radome assemblies, antenna housings, wing tip assemblies and other aircraft and missile parts constructed of fiber laminate subject to the erosive action of rain or hail during flight. Each specification provides for two classes of coatings. One class is electrically nonconductive (Class I) and the other is an anti-static coating for use on radio-compass loop housings and similar areas. Primer and topcoat components are furnished under each specification. Applicable aircraft directives specify the area to be coated and the materials to be used. Surface preparation, application, touch-up procedures, etc., are covered in Section IV of TO 1-1-24.

3-196. PRIMER COATING, INORGANIC, ZINC DUST PIGMENTED, FOR STEEL SURFACES, SPECIFICATION MIL-P-38336.

3-197. This primer is corrosion inhibitive, intended for use on steel and galvanized surfaces, above or below grade, that are subjected to damp or wet environments, i.e., high humidity of 70% or above, water condensate or splash, and marine or severe weather environments. It has high resistance to hydrocarbon solvents, and withstands temperatures up to 750°F. It provides galvanic protection to surfaces; thorough galvanic protection to surfaces; thorough cleaning is, therefore, required to remove rust, scale and oil from surfaces in order that the primer can make intimate electrical contact with the steel. The primer is applied directly to steel surfaces with or without phosphoric acid treatment (Reference TO 1-1-691) which have been roughened mechanically preferably by abrasive blasting. It may be applied to damp, but not to wet surfaces, and may be used alone or with topcoats conforming to Specification MIL-C-38427, Type III, or a variety of proprietary items, applied in accordance with vendor's instructions. (See TO 1-1-691 for appropriate topcoating.) Inorganic zinc primer may appear in versions requiring water as diluent. Storage stability of "Shelf Life" is one year.

**WARNING**

Most inorganic primer contain flammable solvents; hence appropriate safety equipment for prevention and combating fires is required. In confined areas proper respiratory protection must be worn. Contact the Base Safety Office and the Bioenvironmental Engineer for specific details. For brushing, use any paint brush appropriate to the size of the job.

**NOTE**

Inorganic zinc primer MIL-P-38336 is the preferred primer for use in high humidity application at the missile sites.

3-198. **SURFACE PREPARATION.** As this primer is intended to provide galvanic protection, it is essential to remove rust, scale, old paint, oil or other contaminant from receiving surface. To enable good electrical contact with the steel by the primer, steel surfaces shall be solvent cleaned, phosphoric acid treated (Reference TO 1-1-691), or sandblasted. Sandblasting to white metal is preferred. Where sandblasting is not practicable or possible, clean surfaces by means of powered wire brushes, disc sanders, grinding wheels or needle scalers. (Reference TO 1-1-691.) Grind sharp edges to a rounded contour. Remove dust, sand, or grit by vacuuming. Follow this with a solvent wipe with toluene or other solvent which does not leave residue. Clean galvanized surfaces with power tools. The primer can be applied to damp surfaces with good results, but cannot be laid down effectively on excessively wet surfaces. When receiving surfaces are constantly wet, it is highly advisable to eliminate or at least divert as much as possible the sources of wetting during an initial cure phase of 1 hour. Surfaces which continue moist should be solvent wiped with alcohol just prior to application of primer coating.

3-199. **MIXING.** The primer is supplied as a two component kit. The liquid vehicle container holds an amount which when mixed with the zinc dust pigment provides the specified volume of primer. Mix the component materials in the proportions furnished as follows:

a. Mix the vehicle portion thoroughly and separately until all solids are insuspension. Use hand paddles, mechanical devices or any powered stirrers available for this initial mixing operation.

b. Sift the zinc dust pigment slowly into the mixed vehicle while stirring continually. Use either hand methods or a small powered stirrer. Do NOT use a powered shaker type paint agitator to disperse zinc dust in the vehicle.

c. If it is required to mix batches smaller than the unit size, maintain strictly the proportions of vehicle and pigment given by the vendor.

**NOTE**

Proportions customarily are given by weight. In some situations weighing small quantities may be impracticable, and measuring by volume will be necessary. If proportions by volume are not given by the vendor, determine the proper amount by inspection or measurement of contents of a full kit. Zinc dust can pack down considerably. It should be loosened by pouring BEFORE determining volumes, and when measuring volumes for mixing.

d. Stir until pigment is thoroughly wetted and the mixture is free of lumps. If small lumps persist, strain the mixture through a 30 mesh wire screen or through double or triple thickness of cheesecloth before using.

e. When application is by brush, stir moderately and often enough to maintain a homogeneous mixture throughout application.

3-200. **METHOD OF APPLICATION.** Conventional spray application is the preferred method; however, the material can be applied by brush. "Airless", or hydraulic spraying methods are not recommended, as the higher pressure involved -- 1200-2200 psi -- result in the rapid packing of the zinc pigment at valves and orifices. Package viscosity is generally appropriate for brush application. Adjust viscosity of the primer for spraying by thinning in accordance with the vendor's instructions on proportions using the following: (1) The proprietary thinner(s) called out the vendor or (2) either ethyl alcohol, MIL-A-6091, or ethylene glycol monoethyl ether (cellosolve), Specification TT-E-781, FSN 6810-285-4309 (above does not apply to those primers thinned with water).

**CAUTION**

Use ethyl alcohol only where no fire hazards exists. Within enclosed areas and the missile silos use the cellosolve.



**NOTE**

- Vendor's materials can vary to some extent under the controlling Specification MIL-P-38336. The specification calls for inclusion with the package of mixing, thinning, application, and curing instructions. Where the vendor's application instructions differ appreciably from the following general supplementary instructions, the vendor's instructions shall apply.
- It is difficult or impossible to measure viscosity of inorganic zinc primer by means of the standard authorized viscosimetric devices, therefore, this will not be called out. Use the proportions of thinner given by the vendor, adjusting further in small degrees to suit special conditions in accordance with judgment of the painter. Just prior to spraying, wet or damp surfaces shall be wiped clear of moisture films and, (where possible), then solvent wiped with clean cloths wetted with ethyl alcohol or isopropyl alcohol, Specification MIL-F-5566. Spraying technique is conventional. Adjust material tank pressures to that recommended by the vendor or, in absence of this information, to 12-15 psi, or less.

### 3-201. PRIMER COATING, ORGANIC, ZINC DUST PIGMENTED, FOR STEEL SURFACES, SPECIFICATION MIL-P-26915.

3-202. This specification covers two types of organic resin zinc dust pigmented with primer for use on steel surfaces. Both types are compatible with MIL-C-83286 and MIL-C-85285 polyurethane topcoat materials. They are designed for use under severe exposure such as on steel that is normally subjective to outside exposure, condensing moisture, or corrosive atmospheres. The zinc dust primers (MIL-P-26915) are furnished in two types: Type I, Class A, is a solvent-reducible primer, and Type II, Class B, (DEST Corp., P/N 44-GY-16, CAGE 33461) is water reducible. Two coats of primer to a dry film thickness of 4 to 6 mils should be used. For less severe exposure, such as steel which is normally sheltered and not subjected to moisture or corrosive atmospheres, a single coat of primer is adequate. This primer may come two, three, and four component kits.

3-203. SURFACE PREPARATION. As this primer is intended to provide galvanic protection, it is

essential to remove rust, scale, old paint, oil, or other contaminant from receiving surface. To enable good electrical contact with the steel by the primer, steel surfaces shall be solvent cleaned, phosphoric acid treated (Reference TO 1-1-691), or sandblasted. Sandblasting to white metal is preferred. Where sandblasting is not practicable or possible, clean surfaces by means of powered wire brushes, disc sanders, grinding wheels or needle scalars. (Reference TO 1-1-691.) Grind sharp edges to a rounded contour. Remove dust, sand, or grit by vacuuming. Follow this with a solvent wipe using a solvent which does not leave a residue. Clean galvanized surfaces with power tools. The primer can be applied to damp surfaces with good results, but cannot be laid down effectively on excessively wet surfaces. When receiving surfaces are constantly wet, it is highly advisable to eliminate or at least divert as much as possible the sources of wetting during an initial cure phase of 1 hour. Surfaces which continue to be moist should be solvent wiped with alcohol just prior to application of primer coating.

3-204. MIXING. As the mixing and thinning procedures for this material vary from one manufacturer to the next, it is impossible to list the direction in this TO. The vendors direction for mixing shall be followed. To prevent settling of the zinc dust, continuous agitation of the coating is necessary during all painting operations.

3-205. METHOD OF APPLICATION. Conventional spray application is the preferred method; however, the material can be applied by brush. "Airless", or hydraulic spraying methods are not recommended, as the higher pressure involved -- 1200-2200 psi -- result in the rapid packing of the zinc pigment at valves and orifices. Package viscosity is generally appropriate for brush application. Adjust viscosity of the primer for spraying by thinning in accordance with the vendor's instructions on proportions using the following: (1) The proprietary thinner(s) called out the vendor or (2) either ethyl alcohol, MIL-A-6091, or ethylene glycol monoethyl ether (cellosolve), Specification TT-E-781, NSN 6810-00-285-4309 (the above does not apply to those primers thinned with water).

<b>CAUTION</b>
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Use ethyl alcohol only where no fire hazards exists. Within enclosed areas and the missile silos use the cellosolve.

**NOTE**

- Vendor's materials can vary to some extent under the controlling Specification MIL-P-26915. The specification calls for inclusion with the package of mixing, thinning, application, and curing instructions. Where the vendor's application instructions differ appreciably from the following general supplementary instructions, the vendor's instructions shall apply.
- It is difficult or impossible to measure viscosity of inorganic zinc primer by means of the standard authorized viscosimetric devices, therefore, this will not be called out. Use the proportions of thinner given by the vendor, adjusting further in small degrees to suit special conditions in accordance with judgment of the painter. Just prior to spraying, wet or damp surfaces shall be wiped clear of moisture films and, (where possible), then solvent wiped with clean cloths wetted with ethyl alcohol or isopropyl alcohol, Specification MIL-F-5566. Spraying technique is conventional. Adjust material tank pressures to that recommended by the vendor or, in absence of this information, to 12-15 psi, or less.

3-206. INTEGRAL TANK COATING, MIL-C-27725. This is a two part translucent, polyurethane material which provides a corrosion protective coating to integral tank interiors.

**NOTE**

Do not mix more material than can be used in a 5 hour period. Empty containers and those containing mixed and unmixed coating shall be tightly closed when not in use. Empty cans and unused material shall be discarded. The free isocyanates can be deactivated by adding a small quantity of isopropyl alcohol (rubbing alcohol). Mixed material shall be held 24 hours to allow the reaction to go to completion and the material shall be disposed of at the direction of the Bioenvironmental Engineer.

**WARNING**

MIL-C-27725 is flammable and toxic to eyes, skin, and respiratory tract.

Eye and skin protection required. Consult Bioenvironmental Engineering to determine need for respiratory and ventilation requirements.

## 3-207. SAFETY PROCEDURES MIL-C-27725.

a. **RESPONSIBILITY.** The safety and health procedures are mandatory and no deviation will be permitted except by written approval of Office of Safety and/or Bioenvironmental Engineer. It is the responsibility of the immediate supervisor to ensure that all safety and health procedures are followed without deviation.

b. **HEALTH HAZARDS.** The coating material contains harmful solvents and free isocyanates. Inhalation of vapor may cause irritation of the nose, throat, and lungs, and may cause sensitization. Vapors of liquid contact with the eyes or skin may cause severe irritation.

**WARNING**

Until coating MIL-C-27725 has completely cured, personnel required to re-enter coated fuel tanks will observe all safety and health requirements.

c. **PRECAUTIONS.**

(1) Personnel applying the coating by spray or brush shall be protected by wearing:

- (a) Full face air supplied respirator.
- (b) White cotton coveralls.
- (c) Cotton booties or cotton socks.
- (d) Rubber gloves or surgical type gloves.
- (e) Cotton head covering.

(2) Vapors do not dissipate from MIL-C-27725 coating until it is completely cured. Respirator shall be connected to air supply and fitted over face of employee before entering fuel tanks. The respirator shall not be removed from the face while employee is inside the tank.

(3) All clothing shall be washed after each use.

(4) All material used to mop up spilled coating or runs in coating will be placed in water immediately. A small container of water shall be provided in the immediate area.

(5) Blowers shall be circulating air in the fuel cells/tanks before and during entry of personnel to perform any operation such as cleaning. Air shall

flow so that vapors will be carried away from the operator.

(6) All blowers shall be grounded and bonded to the aircraft before operation.

d. FIRE PROTECTION.

**WARNING**

Firefighters shall use self-contained breathing apparatus when fighting fires involving MIL-C-27725.

(1) MIL-C-27725 has a flash point of 266°F open cup, therefore, can present a fire hazard when heated or atomized. Some materials used in this operation have flash points as low as 20°F and will ignite if exposed to a flame or spark.

(2) SPILLS. If MIL-C-27725 is spilled in the repair area, evacuate the area and call the Fire Department. Neutralize with strong ammonia solution, then flush with water.

3-208. PREPARATION OF SURFACE FOR COATING MIL-C-27725.

**WARNING**

MIL-C-38736 is flammable and toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate. MIL-C-81706 is toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Consult Bioenvironmental Engineering Services to determine need for respiratory and ventilation requirements.

3-209. Clean surface to be coated with four part cleaner, MIL-C-38736, using lint-free cleaning cloth. Wipe dry. Do not allow to evaporate. Apply a chemical film conforming to Specification MIL-C-81706. Allow this material to be in contact with the bare metal 3 to 4 minutes, keeping wet by applying more solution as required. Rinse thoroughly with water and air dry. An iridescent yellowish color indicates a clean, well-prepared surface when this coating is used.

**WARNING**

MIL-C-27725 is flammable and toxic to eyes, skin, and respiratory tract.

Eye and skin protection required. Consult Bioenvironmental Engineering to determine need for respiratory and ventilation requirements.

3-210. MIXING OF COATING. Mixing of coating shall be accomplished within an approved ventilated paint booth. If a booth is not available, personnel shall wear an air supplied respirator and mixing shall be accomplished so that vapors are exhausted to an area as provided by the Bioenvironmental Engineer. Mix and blend the two components of the coating thoroughly for a minimum of 5 minutes. Do not mix in contaminated containers. The material shall be stirred with a metal spatula. Empty containers and those containing mixed and unmixed coating shall be tightly closed when not in use.

**CAUTION**

The maximum dry film thickness of coating shall be a 1.2 mils. The minimum thickness of the coating is 0.8 mils. Runs and sags shall be mopped immediately to prevent thick spots. Thicknesses of over 1.2 mils result in cracking, flaking and peeling of coating. Thickness may be measured with a Nordson wet film page.

**NOTE**

Do not mix more material than can be used in a 5 hour period. Empty containers and those containing mixed and unmixed coating shall be tightly closed when not in use. Empty cans and unused material shall be discarded. The free isocyanates can be deactivated by adding a small quantity of isopropyl alcohol (rubbing alcohol). Mixed material shall be held 24 hours to allow the reaction to go to completion and the material shall be disposed of at the direction of the Bioenvironmental Engineer and Environmental Management.

3-211. APPLICATION OF MIL-C-27725 COATING. After surface is thoroughly dry and immediately prior to application of the coating, gently clean with lint-free cleaning cloth using the four part cleaner, MIL-C-38736. Wipe dry, do not allow the cleaner to air dry. Do not abrade the chemical films. Clean small areas starting from the top and farthest from the access door and work down and out using clean lint-free pads. The exception is, if

the area for repair is large there must be alternative cleaning, sealing and coating as the repairman works toward the access door. Use caution not to contaminate a previously cleaned area. If the area is contaminated, it shall be recleaned. All areas that are accessible to spray shall be sprayed when practical; areas that cannot be sprayed shall be coated by brush application. Access doors and removable parts should be spray coated in a spray booth and cured in an area with circulating fresh air. Personnel entering the curing area shall be protected with clothing as stated in "warning." When spraying, apply a light double pass to barely cover the surface. Care shall be taken to prevent runs and puddles. If runs and puddles occur, they shall be removed immediately. The dry thickness of the coating shall be controlled to a thickness of approximately 1.0 mil.

a. Prior to the application of coating MIL-C-27725, and each change, repairmen shall spray or brush a sample on a small strip of aluminum prepared in the same manner as described above. This will allow the repairmen to properly adjust the flow of material from the spray nozzle.

b. Spray Application. Use a standard spray gun DeVilbiss, Model 502 PNPEGA-502 or DeVilbiss, Model P-MDC-510 with nozzle P/N 704FX or 45G. Use a pressure feed tank with 5 psig and an atomizing air pressure of 35 psig. Air lines shall be equipped with filters to remove water from

the lines. Prior to each use, and after each 2 hours of operation, filters shall be drained of moisture. Pressure tanks shall be equipped with an agitator to provide proper pigment suspension. Immediately after use, the equipment shall be thoroughly cleaned with MIL-T-81722, Type II.

c. Brush Coating. A fine camel hair or soft hog bristle brush shall be used when applying coating by brush. The material shall be stirred with a metal spatula every 3-5 minutes.

d. Cure of coating MIL-C-27725. The coating will be tack free in 4 hours under normal conditions (75°F and 50% humidity). Cure may be accelerated after a minimum of 4 hours cure at 75°F by adding heat up to 120°F. The state of cure can be tested by rubbing a test spot with a gauze wet with MIL-T-81722, Type II. Bare metal shall not be exposed after 50 double strokes of the pad at moderate pressure. If bare metal appears the coating is not completely cured.

3-212. LEADING EDGE POLYURETHANE RAIN EROSION RESISTANT TAPE.

a. Description and use. Leading edge polyurethane rain erosion resistant tape is used to provide rain erosion protection for the wing, vertical and horizontal stabilizer, and any other leading edges aft of the engine intakes.

b. Material and equipment list.

MATERIAL	SOURCE	USE
Tape (Width to match area to be covered) Color to match area to be covered Clear	3M Industrial Specialties Division (52152)  NSN 9330-01-338-9994	Leading edge rain erosion protection
Promoter, adhesion	No. 86 3M Company No. 70-0701-8275-6	Promotes tape adhesion
Sealer, edge	Epoweld 8173A Double-bubble NSN 8040-00-092-2816	Seal tape edge, fill fastener head and other voids
Tape, masking	MIL-T-21595 Type I	Masking of application area
Sandpaper, wet or dry 400 Grit		Surface preparation
Pads, nylon abrasive	Maroon or finer	Smoothing of area.
Cheesecloth	CCC-C-440	Cleaning of area and smoothing of leading edge tape
Xacto knife or razor blade		Smoothing and/or trimming
Isopropyl alcohol	TT-I-735A	Cleaning
Pin or 22 gage or finer syringe needle		Air removal
Scraper, plastic	Local manufacture	Tape removal

MATERIAL	SOURCE	USE
Template	Local manufacture from heavy paper or other suitable material (width: same as tape. Length: same as leading edge. Mark centerline for alignment with leading edge centerline.)	Mark area to apply leading edge tape.
Wipers, paper		Cleaning
Remover, adhesive	3M No. 8098	Adhesive removal

## c. INSTALLATION.

**NOTE**

Application temperature should be at least 60° F. This may be accomplished with a ground heater for small areas.

Materials to make repairs or remove material must be available in case of errors in application.

Several types of film are available. Some will not work on aircraft. If you must substitute material, use only that material marked as Outdoor Grade.

Adhesion promoter cannot be substituted. If not available, do not apply film.

Pre-scored liner material is very critical for proper installation. Without the slit liner, application is very difficult.

## d. Surface Preparation.

**NOTE**

Do not apply film to bare metal. Surface must be, at least, primed before film is applied. Allow primer to cure for 24 hours before film application.

(1) Feather, prime and paint the leading edge as required. Feathering chipped/peeled areas is vital for a quality installation. Recommend material be applied to aircraft during phase painting.

(2) Using the, template, align the centerline of the template with the centerline of the leading edge. Mark the top and bottom every two feet of the length of component receiving film.

**NOTE**

Varying widths of tape can be used on a component depending of the amount of leading edge to be covered.

(3) Mask using above marks as guides.

(4) Sand masked area to a smooth surface using 400 grit sandpaper.

**CAUTION**

Final sanding with anything courser than 320 grit sandpaper will adversely affect bond of tape.

(5) Remove residue with cheesecloth moistened with isopropyl alcohol.

**NOTE**

Application temperature should be at least 60° F. This may be accomplished with a ground heater for small areas.

Materials to make repairs or remove material must be available in case of errors in application.

Several types of film are available. Some will not work on aircraft. If you must substitute material, use only that material marked as Outdoor Grade.

Adhesion promoter cannot be substituted. If not available, do not apply film.

(1) Measure two inches either side of damage and apply masking tape along this line.

(2) Trim loose film from damaged area. Cut new film to fit area to be repaired.

(3) Scuff entire area with nylon abrasive pad.

(4) Wipe area thoroughly with isopropyl alcohol.

(5) Apply adhesive promoter to entire area. Allow to dry for 20 minutes.

(6) Apply film and rub thoroughly.

**NOTE**

Ensure air bubbles do not build under film.

(7) Inspect work for air bubbles. Try pressing air out, allowing proper bonding. If not successful, insert needle or pin from the non airflow side and press out air before removing tool.

k. **FILM REMOVAL.**

(1) Film removal is accomplished by peeling it off. For repairs, remove film 1/2 inch on either side of damage.

(2) Remove residual edge sealer by chipping with a plastic scraper.

(3) Mask work area.

(4) Apply adhesive remover per manufacturer's instructions.

(5) Allow to dwell to soften adhesive. Remove with plastic scraper. Repeat as necessary.

(6) Fold paper towel inside an abrasive pad and soak with isopropyl alcohol. Scrub area to remove all adhesive.

(7) Wipe work area with cheesecloth moistened with isopropyl alcohol, turning cheesecloth frequently. Continue until cloth no longer shows dirt.

## SECTION IV

## GENERAL DISCUSSION OF COATING MATERIALS, SOLVENTS, THINNERS AND RELATED SPECIFICATIONS FOR AEROSPACE SYSTEMS

## 4-1. CLASSIFICATION OF ORGANIC COATINGS.

**NOTE**

National Stock Numbers (NSN's) for specific coatings and related materials are to be obtained from Federal Stock Class (normally FSC 8000). Also, see the current Master Cross Reference List (MCRL), C-RL-1-AF to convert specification and parts numbers to National Stock Numbers.

4-2. Customarily, finishing materials are classed as paints, enamels, lacquers, and special coatings such as epoxies and polyurethanes. In common usage there is often little distinction made between the terms; the word "paint" is loosely used to mean all finishing materials. There is now less actual distinction between classes, as the modern coatings now include quite different components in combinations that do not fall into the old categories. Specification coating materials used by the Air Force generally are identified by the established basic classifications above. The following paragraphs define the major classification and give general information on materials falling into these categories which the Air Force uses.

## 4-3. CONSTITUENTS OF ORGANIC COATINGS.

4-4. Modern paints may be a mixture of many things, but the primary constituents are pigment, vehicle (the film former) and solvents. Secondary components (although they may still be of prime importance) may be extenders, driers, anti-oxidants, surfactants, light-filtering agents, or other additives. When special effects are required such as luminescence, fluorescence, fire retardancy, etc., materials to afford these are added.

4-5. **PIGMENTS.** Pigments are finely divided, substantially insoluble, usually opaque materials incorporated into paints to develop color and hiding power, and to provide specific qualities such as light and heat reflectance (or heat absorption), corrosion-inhibition and certain flow characteristics. Pigments may be inorganic or organic types and be of natural or synthetic origin. Examples are the metallic compounds such as zinc oxide and titanium dioxide in the white and light tinted paints, zinc chromate to give yellow coloration (but also serving as a corrosion

inhibitor), chromium oxide for green, iron oxide for red, etc. Synthetic agents or dyes are also widely used. A limited number of pigments are used as corrosion inhibitors in protective paints. The particular pigment used depends upon the metal that is to be protected (whether it is steel or one of the light metals), or the environment to which it is to be subjected. The priming coat material, although satisfactory for corrosion protection at the interface, is generally not suitable for topcoats. Color, weathering properties, or physical durability may be unsatisfactory, and for these reasons the priming coat requires protection by topcoating. An example of corrosion inhibitive pigment used by the Air Force is zinc chromate.

**NOTE**

The theoretical function of a protective paint is the mechanical exclusion of an environment from the metal surface; however, practically, it rarely succeeds in doing so. All organic films are permeable by moisture to some degree. Also, tiny physical defects in a film are usually present in some degree or are acquired in use. It is general practice to supplement the physical protective properties of coatings with agents that provide electro-chemical protection. This is either by means of previous surface conversion treatments (refer to Section II), wash primers, or by the use of corrosion-inhibiting pigments in the priming coats.

4-6. **THE VEHICLE.** The vehicle is defined as the liquid portion of the coating. It is the most significant part of the coating as it furnishes desired qualities of adhesion, toughness, flexibility and resistance to various environments. The vehicle consists of non-volatile and volatile portions. The non-volatile includes resins, drying oils and plasticizers which become the binding agent in the cured film. Upon the evaporation of the volatile portion, the non-volatiles form the actual film on the surface, with pigment, if any, dispersed in it. Vehicles appear in a multitude of combinations, containing many materials. A varnish vehicle as found in enamels generally contains an oil-modified alkyd resin, thinners and driers. A lacquer vehicle consists mainly of resins, solvents and plasticizers.

4-7. PAINT. Some examples of specification paints are as follows:

**NOTE**

Because of the large number of Military and Federal Specifications approved for Air Force use, no attempt has been made to discuss all of them in this technical manual. In addition to the specification material, many items of Air Force equipment and components are coated with proprietary material making logistic support of such equipment difficult. Every effort should be made by responsible personnel to select standard Air Force approved specification material.

4-8. Paint, Aluminum, Heat Resisting (1200-Degree Fahrenheit), Federal Specification TT-P-28.

a. Characteristics. This is heat resistant aluminum paint capable of withstanding temperatures of 1200 degrees Fahrenheit. It is not intended primarily for protecting against corrosion.

b. Uses. Can be used on superheated steam lines, boiler casings, boiler drums, superheated headers and similar high temperature applications.

c. Applications. Apply by brush or by spraying after thinning as recommended by the manufacturer.

d. Drying Time. As recommended by the manufacturer.

e. Thinner. As recommended by the manufacturer.

4-9. PRIMER COATING, ALKYD, WOOD AND FERROUS METAL, SPECIFICATION TT-P-636.

a. Characteristics. This specification covers a combination air-drying and baking, oil-modified alkyd resin primer for ferrous metal and wood. It provides two compositions, one of which is suitable for use under AIR POLLUTION REGULATIONS.

(1) Composition G - For general use.

(2) Composition L - For use in areas with regulations controlling the emission of solvents into the atmosphere.

b. Uses. The primer covered by this specification is intended for priming the clean, rust-free, bare or phosphate-treated ferrous metal parts of vehicles, guns, gun mounts, tanks, metal shipping containers, and similar ordnance material. It may also be used as a sealing undercoat on the wood parts of motor vehicles. It is not intended for use on the inside of potable water tanks, for marine use, for steel

exposed to severe acid or sulfur fumes or steel structures exposed to long-term weathering. It is not intended for use as a lacquer resistant primer; TT-P-664 is recommended for this application.

c. Application. Apply by brush, spraying (cold or hot method) or dipping after thinning as required. Follow manufacturer's directions for specific details.

d. Drying Time. See manufacturer's directions.

e. Thinner. Thin with mineral spirits conforming to Grade 1, Federal Specification TT-E-291.

4-10. PRIMER COATING, SYNTHETIC, RUST INHIBITING, LACQUER-RESISTING. FEDERAL SPECIFICATION TT-P-664.

a. Characteristics. This specification covers a quick drying, rust inhibiting lacquer resisting primer for metal. It provides for an additional composition suitable for use under AIR POLLUTION REGULATIONS.

(1) Composition G - For general use.

(2) Composition L - For use in areas with regulations controlling the emission of solvents into the atmosphere.

b. Uses. The primer covered by this specification is intended for use as base coat on bare or chemically treated metal surfaces. It is suitable for use under either synthetic enamel or lacquer enamel topcoats.

c. Application. Apply by brush, spray (cold or hot method) or dipping after thinning as required. Follow manufacturer's directions for specific details.

d. Drying Time. See manufacturer's directions.

e. Thinner. Follow manufacturer's directions.

4-11. ENAMEL, ALKYD, GLOSS (FOR EXTERIOR AND INTERIOR SURFACES), FEDERAL SPECIFICATION TT-E-489.

a. Characteristics. This is a high-gloss, air drying, alkyd resin base enamel with excellent weather resistant properties. It is flexible and has satisfactory gloss and color retention. The enamel is furnished as air drying (Class A) or baking (Class B).

b. Uses.

(1) It is used on exterior and interior metal surfaces, particularly on smooth exterior metals. Its main use is for refinishing automobiles and construction equipment. Other uses are for machinery, gasoline pumps, trucks, buses, passenger and freight railway cars, metal drums (exterior), metal signs, metal railings and fences, and marine use (above water).



(2) It is not intended for painting houses or interior plastered walls.

c. Application. Brush apply as issued. Spray by conventional methods after thinning with one pint thinner to one gallon enamel or as recommended by the manufacturer.

d. Drying Time.

(1) Class A enamel will air dry dust-free in two hours, hard in eight hours, and full hard in 48 hours. It may be recoated after 24 hours.

(2) Class B enamel will dry hard after 45 minutes at 250 degrees Fahrenheit, or equivalent, and may be recoated after baking. Allow to air dry for 24 hours after baking to obtain a full hard coating.

e. Thinner. Use thinner conforming to Federal Specification TT-T-306.

4-12. ENAMEL, HEAT RESISTANT (400-DEGREES FAHRENHEIT), BLACK, FEDERAL SPECIFICATION TT-E-496.

a. Characteristics. This is heat-resisting enamel furnished in two types.

(1) Type I enamel is unpigmented and consists of a suitable bituminous base, with or without drying oil, and a thinner.

(2) Type II enamel is pigmented resin base coating and is gasoline and water resistant.

b. Uses. For coating metal surfaces subjected to temperatures not higher than 400 degrees Fahrenheit. Typical uses are steam pipes, boiler fronts and similar applications.

c. Application. Apply by brush as issued. Apply by conventional spray methods after thinning as required.

d. Drying Time.

(1) Type I enamel will dry to touch in six hours and dry in 24 hours.

(2) Type II enamel will set to touch in six hours. It will bake hard after air drying for 15 minutes, followed by one hour baking at 220 degrees Fahrenheit.

e. Thinner. Reduce with turpentine meeting Federal Specification TT-T-801 or mineral spirits meeting Federal Specification TT-T-291.

4-13. ENAMEL, ALKYD, LUSTERLESS, FEDERAL SPECIFICATION TT-E-527.

a. Characteristics. This is a combination air drying and baking enamel with an oil-modified

alkyd-resin base. It has satisfactory weather characteristics regarding chalking, fading and other changes but, because of the film porosity, the enamel should be applied over a primer containing a zinc chromate pigment.

b. Uses.

(1) It is used primarily as an exterior camouflage coating when applied over a zinc chromate primer.

(2) It may be applied directly over a semi-gloss enamel when desirable to camouflage existing non-camouflaged equipment.

(3) Black is used for the interior of optical instruments and should be baked for this use.

c. Application. The enamel may be either applied by brush or by conventional spray. Thin with not more than five parts by volume of thinner to 95 parts by volume of enamel for brush application. Thin with not more than 15 parts by volume of thinner to 85 parts of enamel by volume for spray application.

d. Drying Time.

(1) Set-to-touch. Air dry for two hours.

(2) Dry hard. Air dry for eight hours or bake for 45 minutes at 250 degrees Fahrenheit, or equivalent.

(3) Full hard. Air dry for 72 hours or bake for 45 minutes at 250 degrees Fahrenheit, or equivalent, followed by 24 hours air drying.

(4) Recoat. Recoat after dry hard condition is achieved.

e. Thinner. Thin with synthetic enamel thinner meeting Federal Specification TT-T-306 for spraying and with thinner meeting Federal Specification TT-T-291, Grade 1, for brushing.

#### CAUTION

The dry spray dust of lusterless enamels is an extreme fire hazard. Remove dust daily. The danger can be materially reduced by the use of water wash spray booths whenever possible.

4-14. ENAMEL ALKYD, SEMIGLOSS, FEDERAL SPECIFICATION TT-E-529.

a. Characteristics. This is an alkyd-resin base enamel and is issued in two types. Class A, air drying, and Class B, baking. Both have satisfactory weathering qualities.

b. Uses. It is intended primarily for use on painted wood and metal surfaces as an exterior coat for military and other equipment.

c. Application. May be applied by either brush or conventional spray. Apply as issued or by thinning with not more than five parts volume thinner to 95 parts by volume of enamel for brushing. Thin with not more than 15 parts by volume thinner to 85 parts by volume of enamel for spraying.

d. Drying Time.

(1) Dry-to-handle. Air dry Class A for 8 hours. Bake Class B at 250 degrees Fahrenheit for 45 minutes.

(2) Full hardness. Air dry Class A for 72 hours. Air dry Class B for 24 hours after baking at 250 degrees Fahrenheit for 45 minutes.

e. Thinner. Use thinner conforming to Federal Specification TT-T-306.

#### 4-15. ENAMEL, LUSTERLESS, QUICK DRYING SPECIFICATION MIL-E-74.

a. Characteristics. This is a modified, drying - oil phthalic alkydresin, quick-drying synthetic enamel and is furnished as one type and one grade.

b. Use. It is intended as a fast-drying exterior finish coat for military equipment.

c. Application. Apply by brush, conventional spray, or dip methods when thinned as required. The enamel should be of brushing consistency as issued. Reduce with one part thinner by volume to four parts by volume enamel for dipping and two parts by volume thinner to five parts by volume enamel for spray application.

d. Drying Time.

(1) Set-to-touch. Air dry six minutes.

(2) Dry hard. Air dry 10 minutes.

(3) Full hardness. Air dry 72 hours.

e. Thinner. Use thinner conforming to Federal Specification TT-T-306.

#### CAUTION

The dry spray dust of lusterless enamels is an extreme fire hazard. Remove dust daily. The danger can be materially reduced by the use of water wash spray booths whenever possible.

4-16. Deleted.

#### 4-17. LACQUER, CAMOUFLAGE, FEDERAL SPECIFICATION TT-L-20.

a. Characteristics. This is a nitrocellulose lacquer containing a coconut oil modified, phthalic alkyd resin and is supplied in various colors.

b. Use. This lacquer is for use on metal surfaces as a camouflage finish. For best results, apply over Specification TT-P-1757 zinc-chromate primer that has been applied over Specification MIL-P-8514 pretreatment. It may be applied over Specification MIL-P-7962 acrylic-nitrocellulose system. Do not use acrylic-nitrocellulose lacquers to touch-up nitrocellulose lacquers.

c. Application. Apply by spraying (hot or cold method), brush, or dipping, after thinning as required. The lacquer will blush when applied under high humidity conditions.

d. Drying Time. A film thickness of about 1.0 mil will dry hard in approximately 40 minutes under standard conditions.

e. Thinner. For spraying, thin with approximate equal volumes of thinner conforming to Federal Specification TT-T-266. To alleviate blushing under high humidity conditions add up to one pint thinner per Federal Specification TT-E-776 to each gallon thinner per Federal Specification TT-T-266.

#### 4-18. LACQUER, CELLULOSE NITRATE, GLOSS, TT-L-32.

a. Characteristics. This is a low water sensitive cellulose nitrate coating for metal surfaces. It may be applied over zinc chromate primer, epoxy primer (MIL-P-23377), polysulfide primer (MIL-P-87112) and other compatible primers. Do not apply over bare metal directly. This lacquer is not resistant to diester lubricating oils.

b. Uses. It is intended for use on associated aircraft equipment and as an alternate to the acrylic nitrocellulose system for general aircraft use.

c. Application. Apply by spray (hot or cold method) after thinning as required. The material may be brush applied; however, the use of this method should be held to a minimum.

#### NOTE

Aluminum lacquer may be prepared by adding 12 ounces of aluminum paste conforming to Federal Specification TT-P-320, Type II, Class A, to one gallon of clear lacquer with the aid of thinner as required. Aluminum powder of equal quality and in equivalent amounts may be substituted for the paste.

d. Drying Time.

(1) Recoat. Air dry 45 minutes.

(2) Full hard. Air dry 18 hours.

e. Thinner. Use thinner conforming to Federal Specification TT-E-776.

#### 4-19. LACQUER, ACRYLIC NITROCELLULOSE, GLOSS, FOR AIRCRAFT USE, SPECIFICATION MIL-L-19537.

a. Characteristics. This lacquer is primarily for use as a general purpose exterior protective coating on aircraft surfaces and is formulated for increased resistance to diester lubricating oils.

b. Uses. It is used over a system consisting of wash primer (pretreatment coating) and lacquer type primer, Specification MIL-P-7962. The coating does not adhere well to zinc chromate primer, Specification TT-P-1757.

#### NOTE

Acrylic nitrocellulose has poor adhesion to cellulose nitrate camouflage lacquer, Specification TT-L-20, and to cellulose nitrate gloss lacquer, Specification TT-L-32.

#### 4-20. LACQUER, ACRYLIC NITROCELLULOSE, CAMOUFLAGE, FOR AIRCRAFT USE, SPECIFICATION MIL-L-19538.

#### NOTE

This lacquer is similar to MIL-L-19537 in characteristics, usage and application method.

4-21. PRETREATMENT (WASH PRIMER). The term "wash primer designates a specific material which combines the properties of inhibitive wash coat or metal conditioner with the properties of the conventional anti-corrosive primer. The essential components of wash primers are phosphoric acid, chromate pigment and polyvinyl butyral resin. Wash primers can be formulated that are equally effective over iron, steel, aluminum, treated magnesium, copper, zinc and a wide variety of other metals. The advantages of wash primers used by the Air Force are listed below.

a. Easily applied and dry rapidly.

b. Useable over wide ranges of temperatures and humidity.

c. Can be applied to a variety of metals with good results.

d. Provide temporary protection until protective coating is applied.

e. Prevent or retard under-film corrosion.

f. Exhibit high degree of adhesion to metals.

g. Up-grade performance of subsequent protective coatings.

#### 4-22. COATING COMPOUND, METAL PRE-TREATMENT, RESIN ACID, SPECIFICATION MIL-C-8514.

a. Characteristics. This specification covers a smooth finish, spray-type pretreatment coating furnished in two parts - resin component and acid component. The materials must be mixed prior to use.

b. Uses.

(1) As a pretreatment on clean metal surfaces of all types prior to applying subsequent coatings. Its purpose is to increase the adhesion of the coating system.

(2) As a tie coat between the base metal and primer in the acrylic nitrocellulose system used on aircraft.

#### NOTE

- Refer to Section III for detailed application procedures.
- Specification MIL-C-15328, Coating Pretreatment (Formula No. 117 for metals), covers a material very similar to Specification MIL-C-8514 material. The main difference is the fineness of grind of the pigment.

4-23. PRIMERS. Primers are used on metals to provide an adherent coating to which subsequent coatings will firmly adhere and provide protection for the metal against corrosion. The pigment portion of primers for ferrous base metals usually consists of iron oxide, lead chromate, red lead, zinc chromate, zinc oxide, zinc dust or a mixture of these. Zinc chromate is the principal pigment in primers used on aluminum, magnesium and their alloys.

#### 4-24. PRIMER, COATING, INORGANIC, ZINC DUST PIGMENTED, SELF CURING, FOR STEEL SURFACES, SPECIFICATION MIL-P-38336.

a. Characteristics. This is a ready-to-mix two-component, corrosion inhibitive primer consisting of a liquid inorganic vehicle and zinc dust pigment (Type II, TT-P-460) in separate containers. It has excellent resistance to moisture and organic solvents and withstands temperatures to 750 degrees Fahrenheit.

b. Uses. This primer is for general use on steel or galvanized surfaces subjected to severe weather environments, i.e., high humidity of 70% or above,

“water condensate or splash, mildly corrosive atmospheres, and marine environments. It may be used under a variety of topcoats conforming to Specification MIL-C-38427, Type III. It is not for use in direct contact with acids, alkalies or salts. It is the preferred primer for use in missile silo environments.

**4-25. PRIMER, COATING, CELLULOSE NITRATE MODIFIED ALKYD TYPE CORROSION INHIBITING, FAST DRYING, SPECIFICATION MIL-P-7962.**

a. **Characteristics.** This is a corrosion-inhibiting, fast-drying, spray type, zinc chromate lacquer primer for use over pretreatment coating (wash primer). It is compatible with the acrylic nitrocellulose lacquer topcoat.

b. **Use.** The primer is formulated for use as a tie coat between a pretreatment coating and topcoating conforming to Specifications MIL-L-19537 or MIL-L-19538. Do not use without a prior bond coat of wash primer or in any application in which a topcoat will not be applied. The MIL-P-7962 primer may be used without a topcoat in interior locations only.

**NOTE**

Do not use primer over two years old without first checking to insure it meets specification requirements.

4-26. Deleted.

**4-27. PRIMER COATING, ZINC DUST PIGMENTED FOR STEEL SURFACES, SPECIFICATION MIL-P-26915.**

a. **Characteristics.** This is a zinc dust primer for use on steel surfaces of ground support equipment. The primer is available in two types: Type I, Class A, is a solvent reducible primer, and Type II, Class B, is a water reducible primer. The primer can be single or two-component with the dry zinc dust in another container. Two coats of primer to a dry film thickness of 4 to 6 mils should be used.”

b. **Use.** The primer is for use on steel surfaces. Use two coats for severe exposure such as on steel that is normally subjected to outside exposure, condensing moisture, or corrosive atmospheres. If color or finish texture is important, a coat of enamel or lacquer may be substituted for the second coat of primer.

c. **Application.** After thinning per manufacturers recommendations, apply by spray (hot or cold method) over solvent cleaned, phosphoric-acid-treated or sandblasted steel. The primer may be brush applied but only to small areas. The vendor's direction for mixing shall be followed. To prevent settling of the zinc dust, a mixer shall be used to provide continuous agitation of the coating during all painting operations.

d. **Drying Time.** The primer shall be dry dust-free in not more than 10 minutes and dry through in not more than two hours.

e. Thinner. Thin with mineral spirits conforming to Federal Specification TT-T-291 in ratios up to one part of thinner to one part of primer by volume.

#### 4-28. PRIMER COATING, EPOXY, FOR AIRCRAFT APPLICATION, SPECIFICATION MIL-P-23377.

a. Characteristics. This is a two-component, pigmented, epoxy primer particularly formulated for its adhesion properties. It is very resistant to chemicals, lubricants, and corrosive atmospheres; but it has only fair weathering characteristics. Because it is an epoxy, this primer is difficult to remove with standard paint removers.

b. Uses. As a primer for polyurethane topcoat per Specification MIL-C-27227 and MIL-C-83286. Used for special aircraft application.

c. Application. See paragraph 3-158.

#### 4-29. PRIMER COATING, ELASTOMERIC, POLYSULFIDE, CORROSION INHIBITING, SPECIFICATION MIL-P-87112 (USAF).

a. Characteristics. This is a two-component, polysulfide primer, particularly formulated for its corrosion resistance and flexibility. It is a superior material for protection of relatively flexible aircraft structures as it does not crack or peel away from fasteners in highly stressed areas, and it will not crack, peel, or rupture from lap and butt joints. The physical properties of this primer on large flexible aircraft structures will increase the longevity of the paint system as well as decrease maintenance and corrosion rework during the life cycle of the coating system.

b. Uses. As a primer for polyurethane topcoat per specification MIL-C-83286. Use of this primer shall be determined by the Weapon System Manager.

c. Application. This two component primer is packaged and furnished as a kit, and the mixing ratio of the primer shall be as recommended by the manufacturer. The primer (Type I or II) can be applied by conventional spray, (Type III) by airless spray, or (Type IV) by electrostatic airless spray. The primer has a 2-hour pot life. See paragraph 3-162.

#### NOTE

It is mandatory that spray equipment be cleaned immediately after use.

#### 4-30. PRIMER COATING, EPOXY, VOC COMPLIANT, CHEMICAL AND SOLVENT RESISTANT, MIL-P-85582 CLASS II.

a. Characteristics. This is a two-component, water-reducible epoxy primer formulated to meet most local environmental pollution regulations including the California Air Resources Board Rule 1124. It is also lead free.

b. Uses. As a primer for polyurethane topcoat. It is a suitable replacement for MIL-P-23377 where low VOC regulations are in force.

c. Supply. This is a new specification for which a Qualified Products List (QPL) has not yet been issued by the preparing activity, The Naval Air Engineering Center, and for which NSNs have not yet been issued. To meet immediate needs, a commercial item, Deft Chemical Co Primer 44-GN-24, or Desoto, Inc., Primer 513X408/910X831, is authorized for interim use, but shall have to be acquired by local purchase procedures.

d. Application. See paragraph 3-159.

#### 4-31. PRIMER COATING, POLYURETHANE, ONE COMPONENT, TT-P-2760.

a. Characteristics. This is a one-component, moisture-cure, polyurethane primer. It does not meet low VOC requirements. This primer has high flexibility.

b. Uses: As a primer for polyurethane topcoat. It is a suitable replacement for MIL-P-23377 and it is the preferred touch-up primer for both MIL-P-23377 and MIL-P-85582 on exterior surfaces. Because of this primer's flexibility. It is recommended for high impact areas such as leading edge slats.

c. Supply. This is a new specification for which a Qualified Products List (QPL) has not yet been issued by the preparing activity, The Naval Air Engineering Center, and for which NSNs have not yet been issued. To meet immediate needs, a commercial item, as listed below is authorized for interim use, but shall have to be required by local purchase procedures.

SPECIFICATION NUMBER	DESOTO PRODUCT NUMBER	DESCRIPTION
MIL-P-85853, Type I, Class II	823X439	Yellow, standard version, VOC** 590 g/l
MIL-P-85853, Type II, Class II	825X480	Dark green, low IR version, VOC** 590 g/l

- d. Application: See paragraph 3-160.
- e. Drying Time: See paragraph 3-160.

#### 4-32. COATING KIT, STEEL TANK INTERIOR, SPECIFICATION MIL-C-4556.

a. Characteristics. This is a protective coating system for lining interior of steel tanks and is furnished as two classes. Class 2 is an air dry coating suitable for application over sand or grit blasted steel. Class 3 is suitable for application to commercial carriers transporting fuels and oils for delivery to governmental agencies. The material may be supplied as a twocomponent topcoat plus a primer.

##### b. Uses.

(1) For lining the interior steel surfaces of fuel, oil and water carriers and storage tanks (excluding potable water tanks).

(2) Class 2 material is intended for application on government equipment, and commercial equipment used to deliver fuel directly to government aircraft under contract.

(3) Class 3 material is intended for application on commercial carriers used in delivering fuel to a government activity and will not be used on government equipment.

c. Application. Apply by spraying (hot or cold method) or as recommended by the manufacturer. The pot life will be at least six hours at 75 degrees Fahrenheit.

d. Drying Time. The system will dry hard after air drying at 75 degrees Fahrenheit for 24 hours.

e. Thinner. As recommended by the manufacturer.

#### 4-33. WALKWAY COATING, SPECIFICATION MIL-W-5044.

a. Characteristics. This coating is furnished in three types of nonslip walkway materials.

(1) Type I. Coating, smooth texture (without grit) (primarily for brush application).

(2) Type II. Coating, rough texture (with grit) (primarily for brush application).

(3) Type III. Matting (for use with separate liquid adhesive).

b. Uses. Intended to provide nonslip surfaces on aircraft wing walkways. Use Type I where aerodynamic properties are a major factor.

c. Application. Apply Types I and II by brush and Type III with an adhesive.

#### NOTE

Refer to Section IV for detailed application procedures.

##### d. Drying Time.

	Type I	Type II
Tack free (minutes)	15	15
Dry for recoating (minutes)	30	30
Dry through (hours)	6	6
Full hardness (hours)	24	24

e. Thinner. As recommended by the manufacturer.

#### 4-34. COATING, SPRAYABLE, STRIPPABLE, PROTECTIVE, SPECIFICATION MIL-C-6799.

a. Characteristics. This is strippable coating furnished in the following types and classes:

(1) Type I. Single Coat - Interior or under cover

(a) Class 1 - Transparent.

(b) Class 2 - Opaque.

(2) Type II. Multi-coat system - Exterior

(a) Class 1 - Base coat (black)

(b) Class 4 - Contrasting intermediate coat (gray)

(c) Class 5 - Top coat (white or olive drab)

(3) Type III. Single Coat - Exterior (white or olive drab)

- (a) Class 1 - Long-term protection
- (b) Class 2 - Short-term protection

b. Uses.

(1) Type I, Class 1. This material is intended for use as a single coat, interior, transparent strippable protective coating for acrylic plastic bulk materials and assemblies containing acrylic plastics when the protected item is shipped fully covered or stored under cover. It can also be used where the protected acrylic must undergo processes of sawing, sanding, drilling, or routing.

(2) Type I, Class 2. This material is intended for use as a single coat, interior, opaque strippable protective coating for acrylic plastic bulk materials and assemblies containing acrylic plastics when the protected item is shipped fully covered or stored under cover. It can also be used where the protected acrylic must undergo processes of sawing, sanding, drilling or routing.

(3) Type II, Class 1. Black. This material is intended for use as (1) a strippable protective coating for acrylic plastic bulk materials and assemblies containing acrylic plastics when the protected item is shipped fully covered or stored under cover, and (2) as a basecoat for Type II, Class 5 materials.

(4) Type II, Class 4. Gray. This material is intended to be used only as a contrasting, intermediate coating to be applied over Type II, Class 1, black, basecoat material.

(5) Type II, Class 5. White or Olive Drab. This material is intended to be used only as a topcoating for Type II, Class 1 or a combination of Type II, Class 1 and 4 materials. In combination this protective system serves as a sprayable, strip-pable, protective coating for application on metallic, painted and plastic surfaces, such as: entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and overseas deck-loaded shipments.

(6) Type III, White or Olive Drab. This material is intended for use as an exterior, single coat strippable protective coating for application by spraying on plastic, painted, and metallic surfaces such as entire aircraft, missiles, rockets, and transportation vehicles during outdoor storage and overseas deck load shipment. Class 1 material is intended to provide long term protection (up to 1 year). Class 2 materials is intended to offer shorter term protection (up to 6 months).

c. Application. Apply by conventional spray methods after thinning as required.

d. Drying Time.

(1) Type I, Type II, Classes 1 and 2. Coating 3 mils thick will dry to touch in three hours and

an 8 to 10 mils coat will dry thoroughly in eight to 16 hours.

(2) Type II, Class 3. Coating of 1 mil thickness will dry to touch in one hour.

e. Thinner.

(1) Type I, Type II, Classes 1 and 2. Dilute with tepid tap water (3 ounces per gallon maximum).

(2) Type II, Class 3. None required.

4-35. COATING SYSTEM, POLYURETHANE, RAIN EROSION RESISTANT FOR EXTERIOR AIRCRAFT AND MISSILE PLASTIC PARTS, SPECIFICATION MIL-C-83231.

a. Characteristics. This system consists of two types. Type I is a rain erosion resistant coating and Type II is an anti-static rain erosion resistant coating. Types I and II consist of a primer plus activator and a polyurethane prepolymer solution plus catalyst.

b. Uses. Types I and II coatings are intended for exterior laminated plastic parts and radomes of highspeed aircraft and missiles, for protection from rain erosion while in flight. Type II coating will also discharge and dissipate static electricity, alleviating radio and radar interference.

c. Application (see TO 1-1-24).

d. Thinners and drying time. As recommended by manufacturer (see TO 1-1-24).

4-36. Deleted.

4-37. COATING, POLYURETHANE, ALIPHATIC, SPECIFICATION MIL-C-83286.

a. Characteristics. This is a two-component, polyurethane coating for use on exterior metal surfaces. The coating consists of a pigmented polyester resin base component and an isocyanate catalyst.

b. Use. This material is intended for use as a protective coating for exterior of aircraft and missiles. It is applied over primer, Specification MIL-P-23377.

c. Application. Apply by spray after mixing equal volume of catalyst and pigmented coating. Minor viscosity adjustments may be required to obtain the spraying consistency.

**CAUTION**

Keep away from flames. Provide adequate ventilation during mixing and application and avoid vapor.

**NOTE**

This is the standard system for USAF aircraft and missiles. Refer to Section IV for detailed application procedures.

- d. **Drying Time and Thinning.** See Section IV of this manual.

<b>WARNING</b>
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The catalyst portion of the polyurethane topcoat contains a resin which may contain a maximum of 1% free toluene diisocyanate (TDI). This material is toxic in low atmospheric concentrations, and is a strong respiratory and skin irritant. Personnel handling, mixing and spraying the polyurethane topcoat shall wear coveralls, face masks (or hoods) and gloves. The wearing of chemical organic respirators is required and shall be coordinated with the medical services. Whenever painting is done in a confined area, an air supplied respirator is mandatory for all personnel in the area. Report any skin irritation or other reaction to the Medical Officer immediately. Personnel with a history or respiratory problems or known sensitivity to epoxy or polyurethane should not be employed in this work.

#### 4-38. RESIN COATING, UNPIGMENTED, FOR ENGINE COMPONENTS AND METAL PARTS, SPECIFICATION MIL-R-3043.

- a. **Character.** This is a permanent resin coating for baking only. The base material is a thermosetting resin, free form drying and non drying oil-sand celluloses. The resin coating is supplied in only one type under this specification.

- b. **Uses.** The coating is used as a permanent corrosion preventative, oil resistant coating for metallic non-bearing surfaces of engine parts, air-frame components, magnesium parts, gun mounts, gear housings, and other components. The material is specifically used on the interior surfaces of dropable steel tanks and tubing of methylbromide or trifluorobromethane fire extinguishing systems.

- c. **Application.** Apply by dip or spray at room temperature.

- d. **Drying Time.** The coating will air dry to handle in 30 minutes at room temperature after which it may be fully cured by baking in oil or by oven baking.

- (1) **Baking in oil.** Air dry for 16 to 24 hours and immerse in hot lubricating oil for 15 minutes.

- (2) **Oven baking.** Air dry for one hour followed by 30 minutes baking at 325 degrees Fahrenheit.

- e. **Thinner.** As recommended by the manufacturer.

#### 4-39. SOLVENTS.

4-40. At ordinary temperatures the consistency or viscosity of mixtures of oils, pigments and resins that make up coating materials is too high to allow spreading them effectively over surfaces in the desired thicknesses. Also, most resins are solids and need to be dissolved before they can be dispersed in a liquid. A solvent has the essential function of reducing the viscosity of the vehicle portion of the material to the point where it can be managed. Solvents do not react chemically with coating constituents (nor do they dissolve pigments) and ultimately they are lost from the coating by evaporation, having served their purpose. Most solvents are organic materials and are classified by their chemical structure as alcohols, esters, ketones, etc. In practice, they must be considered from the standpoint of their powers of solvency. Power of solvency is expressed in reference to some material. A liquid may dissolve one substance well, another poorly, and still others not at all. There is no universal solvent in coating technology. A liquid which does not dissolve a given substance may, however, be used as a diluent with respect to it.

**NOTE**

Although in practice the terms solvent, diluent and thinner are often used interchangeably to describe a liquid, it should be understood that, properly, the words have different meanings, and the mechanism of solvents and diluents or thinners are different. For example, a solvent will thin incidentally while performing its prime purpose of dissolving something; whereas a diluent or thinner is used to reduce viscosity (and regulate evaporation) and is not required, and may be unable to dissolve any constituents of the coating concerned. A thinner must, of course, be compatible with the coating. This compatibility is beyond determining in the field; hence, only authorized thinners specifically called out for use with a given coating should be used to thin it.

4-41. Solvents and diluents are frequently used together in coating formulations, and the purpose of



a liquid decided whether it is “solvent” or “diluent”. For example, mineral spirits is a solvent for linseed oil, but not for cellulose nitrate. But solutions of cellulose nitrate (in butyl acetate) will tolerate substantial amounts of mineral spirits and here the mineral spirits can be used as a diluent with respect to the solution. (Diluents and thinners are normally less expensive than solvents). Generally the solvent portion is itself a blend of solvents, each one chosen for its power to dissolve a particular constituent of the coating, and each present in proportion to regulate evaporation at a rate which will prevent premature segregation of any single dissolved constituent.

#### NOTE

To distinguish between “diluent” and “thinner”, the material added by the manufacturer to adjust viscosity should be called “diluent”, while the material added by the painter for the same purpose should be called “thinner”.

#### 4-42. VOLATILITY OF SOLVENTS, DILUENTS AND THINNERS.

4-43. Volatility, the rate at which a solvent vaporizes, governs the length of time a paint film remains fluid. It thus affects performance characteristics of the paint film when deposited, such as the smoothness of the flowout, the time an edge remains wet to enable blending of overlapped strokes of the spray gun or brush, the tendency to sag or run, the drying time, and others. Volatility also largely governs the flash point of materials.

#### NOTE

The very properties that make a substance a good solvent for organic materials tend to make it harmful to the body. By their nature many are also hazardous due to flammability. Caution should be used to avoid unnecessary and continued exposure to the volatile constituents of paints either by inhalation or by skin contact. Precautions must be taken at all times to prevent accidental ignition.

#### 4-44. THINNERS.

4-45. Thinner is the material added by the painter to a coating material to adjust its viscosity. The following specification thinners are among those used in Air Force painting:

a. Deleted.

b. TT-T-266, thinner for nitrocellulose dopes and lacquers of the spraying types. It is called out

for use with lacquers TT-L-20, TT-L-32, TT-L-58 and lacquer primer MIL-P-7962.

#### CAUTION

The thinner should not be used with acrylic nitrocellulose lacquers MIL-L-19537 and -19538.

c. TT-T-306, synthetic enamel thinner, used with the following for spray application: Enamels TT-E-489, TT-E-527 and TT-E-529, (Class A).

d. Deleted.

e. MIL-T-81772 Aircraft Coating Thinner covers three types of thinners to be used for reducing the standard aircraft coatings. They are suited for use but are not necessarily limited to the following applications:

(1) Type I is used with Polyurethane coating, MIL-C-83268, or other coatings as authorized.

(2) Type II is used with Epoxy Primer, MIL-P-23377, or other coatings as authorized.

(3) Type III is used with lacquers, such as MIL-L-19537, MIL-L-81352 or other coatings as authorized.

f. Deleted.

g. Special purpose “thinners” are often added to coating materials to provide good drying characteristics under abnormal environmental conditions. High boiling point solvents such as diacetone alcohol (O-D-306) and butyl alcohol (TT-B-846) are often added to prevent blushing.

#### 4-46. RESINS.

4-47. Natural resins are solid organic substances of vegetable or animal origin. Synthetic resins are man-made substances physically similar to natural resins. Rosin and shellac are examples of natural resins. Synthetic resins have largely taken over in modern coating formulations and can be made to measure to furnish desired characteristics. The coating materials described in this technical manual are almost exclusively based on synthetics. Following are examples of resins and their special characteristics:

a. Alkyds. The backbone of modern paints in a great many combinations. Specification MIL-E-7729, MIL-E-5556, MIL-E-74, and Federal Specification TT-E-489, TT-E-527, TT-E-529, all described alkyd or modified alkyd enamels used by the Air Force. The alkyds are characterized by toughness, flexibility and durability, and are used in exterior and interior coatings for utility and decorative purposes. They do not have good chemical resistance.

b. **Acrylics.** The acrylics have outstanding light resistance and outdoor weather durability, with moderate chemical resistance. Used with nitrocellulose as a hardener, they have better drying properties and increased hardness. Specifications MIL-L-19537 and MIL-L-19538, are representative of the acrylic/nitrocellulose type.

c. **Vinyls.** These have limited aircraft application, but where construction materials, metal and wood must be protected from high humidity or acid or caustic environments vinyls are used. Examples are the marine type vinyl/alkyd paints. Specification MIL-P-15932, MIL-P-15933, MIL-P-15934, MIL-P-15135, MIL-15936, with corresponding primer, Specifications MIL-P-15930 (vinyl-zinc chromate) or MIL-P-15929 (vinyl-red lead). These are coming more into Air Force use at missile sites.

d. **Phenolics.** These resins appear in varnishes and enamel requiring extra hardness and abrasion resistance. Federal Specification TT-V-119 spar varnish and Specification MIL-E-12507 enamel are examples.

e. **Silicones.** These resins appear primarily in heat resistant coatings. They are not particularly hard surfaced and may craze. They are usually baked.

f. **Epoxies.** Epoxies have outstanding adhesion and chemical resistance. In combination with other resins they appear as baking enamels. Air drying types are reacted with converting agents for prior to application to set up films of improved characteristics. The Air Force uses Specification MIL-P-23377 primer in its polyurethane system.

g. **Polyurethane.** These resins are also converted or catalyzed in coating applications. The Air Force polyurethane coating, Specification MIL-C-83286, is characterized by very high gloss, superior toughness and outdoor durability, and good chemical resistance.

#### 4-48. ADHESION.

4-49. To obtain good adhesion of organic coatings to metal, the surface must be mechanically and chemically clean. A smooth or highly polished surface offers little inter-adhesion and should be roughened to provide "tooth" for physical bonding. Adhesion to smooth materials such as glass is difficult and surface etching is essential. With plastics etching may be augmented by solvent action to obtain some degree of fusion with the surface.

## SECTION V

### APPLICATION AND REMOVAL OF DECALCOMANIAS (DECALS) AND SILK SCREENING

#### 5-1. DECALS - GENERAL.

##### NOTE

National Stock Numbers (NSN's) for specific decals and related materials are to be obtained from Federal Supply Class, normally FSC's 7690, 9330, 9905 and others as may be found in Illustrated Parts Breakdowns (IPB's) for particular aircraft. Also, see the current Master Cross Reference List (MCRL), C-RL-1-AF to convert specification and part numbers to National Stock Numbers. See paragraphs 1-15 thru 1-18 of TO 1-1-4 for requisitioning procedures and other related decal information.

5-2. Decals (decalcomanias) are defined as specially prepared film (plastic) containing designs, words, numerals and/or colored marking stripes/bands, which may be applied or attached to other Air Force equipment as a method of marking and/or identification.

5-3. The decals can be used in lieu of paint for internal and external markings and insignia as authorized by TO 1-1-4.

5-4. The decals shall conform to MIL-P-38477 and are available in solid or perforated (holes) film. It is emphasized, however, that decals with perforated holes shall only be applied over painted surfaces. For application to pressurized areas on aircraft exteriors, prepared (factory) perforated film should be used. This will prevent blistering due to leaking rivets, seam, etc.

5-5. Non-perforated, premasked decals may be applied directly to the primer prior to applying the topcoat. This applies to any primers authorized in this manual; however, perforated decals may be applied directly to epoxy primer, MIL-P-23377 only. Decals applied prior to the topcoat must be premasked with low tack translucent application/mask tape, leaving a 1/16 inch uncovered lip around the decal edge. This lip will allow the topcoat paint to seal the edge of the decal, eliminating the need for edge sealer. The mask is removed after the topcoat paint is allowed to cure.

5-6. Decals are not authorized for use on unpainted surfaces.

##### CAUTION

Do not apply decals when the temperature is below 45 degrees Fahrenheit as early failure will occur.

##### NOTE

If applications of decals, Specification MIL-P-38477 are required at temperatures from 45 degree Fahrenheit to 60 degrees Fahrenheit, activate the pressure sensitive adhesive as per instructions supplied by the manufacturer.

#### 5-7. SURFACE PREPARATION.

5-8. The integrity of the decals installation is largely dependent upon proper preparation of the surface to which the decals is to be applied. It is, therefore, emphasized that the following be accomplished prior to application of decals to aircraft surfaces.

a. Remove exceptionally oily or greasy contaminants using solvent Federal Specification P-D-680 Type II in accordance with TO 1-1-691.

b. In areas where the decal will be applied, buff very lightly with very fine aluminum oxide abrasive mat Specification MIL-A-9962 Type I Grade A.

c. Clean the entire application surface thoroughly with alkaline cleaner Specification MIL-C-87936 in accordance with TO 1-1-691.

d. To check surface cleanliness of bare, anodized, or alodine surfaces, a "water break" test shall be used. The cleaned surface shall permit an unbroken thin film of water when the area is tested in accordance with Section III of this manual.

e. Optional use of a glass or clear-coat coating applied underneath aircraft decals for adhesion purposes on camouflage aircraft is authorized.

#### 5-9. APPLICATION PROCEDURES FOR DECALS AND COLORED MARKING STRIPES.

5-10. The application of decals films authorized by TO 1-1-4 is accomplished according to the basic methods detailed below. These methods refer generally to simple shapes of the approximate sizes

noted. Application of intricately cut shapes require the use of application type.

#### 5-11. SMALL DECALS AND MARKING STRIPES.

5-12. Decals Up To 12" x 2". Remove entire backing from adhesive. Align decal and press on edge to surface with finger. Hold remainder of film taut and slightly away from surface until pressed down with plastic squeegee using firm, overlapping strokes (See figure 5-1).



Figure 5-1. Applying Small Decal

5-13. FILM FOR STRIPPING. Pull off backing for approximately 12 inches, exposing the adhesive. Press end in position and apply the stripping as the backing is removed. Press firmly to surface with a plastic squeegee. Be sure all edges are firmly adhered (See figure 5-2).

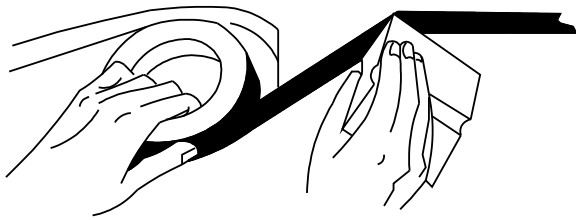


Figure 5-2. Applying Marking Stripe

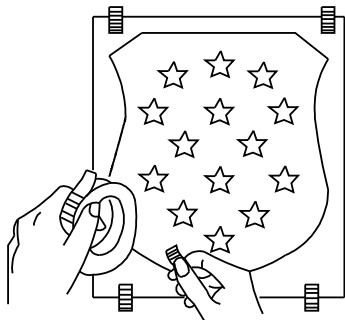


Figure 5-3. Applying Large Emblem, Step 1

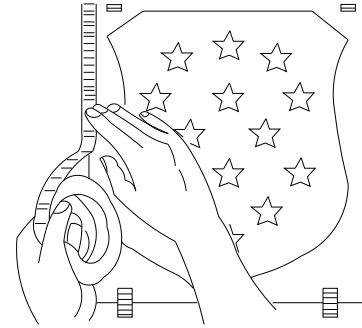


Figure 5-4. Applying Larger Emblem, Step 2

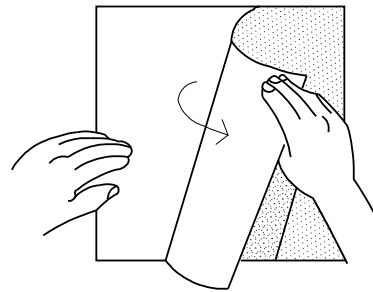


Figure 5-5. Applying Larger Emblem, Step 3

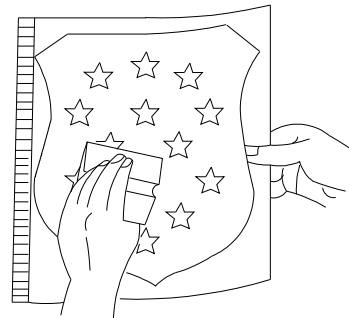


Figure 5-6. Applying Larger Emblem, Step 4

5-14. Larger Emblems and Letters. Decals applied using a "Hinge" method as outlined below.

a. Tape decal into position with small pieces of masking tape (See figure 5-3).

b. Apply 1" or 2" tape over one edge to serve as a hinge. Whenever possible, hinge narrow edge. (See figure 5-4) (If surface requires that longer edge be hinged, it may be necessary to use carrier method.) be more convenient to peel the liner back a few inches at a time as the application progresses). (See figure 5-5.)

c. Hinge back and squeegee or roll emblem to surface with firm, overlapping strokes. Hold sheeting away from surface with one hand and allow

adhesive to touch only as pressure is applied. Be sure the edges are firmly adhered. (See figure 5-6.)

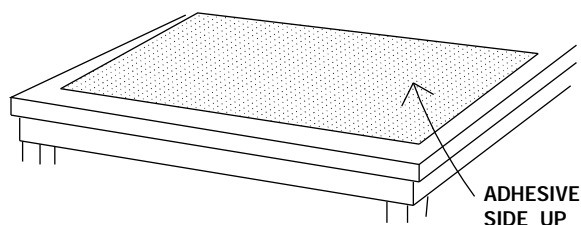


Figure 5-7. Use of Application Tape, Step 1

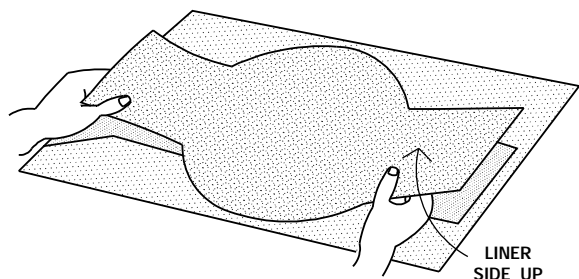


Figure 5-8. Use of Application Tape, Step 2

**5-15. DECALS APPLIED USING APPLICATION TAPE.** This method is particularly useful with large or intricately shaped emblems or for hot weather applications. Steps under figure numbers 5-7, 5-8, and 5-9 are not necessary when decals are supplied premasked (cut to same shape as decal with application tape).

- a. Place a piece of application tape with the adhesive side up on a flat, rigid surface. (See figure 5-7.)

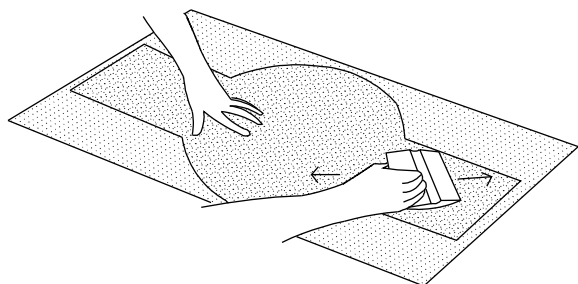


Figure 5-9. Use of Application Tape, Step 3

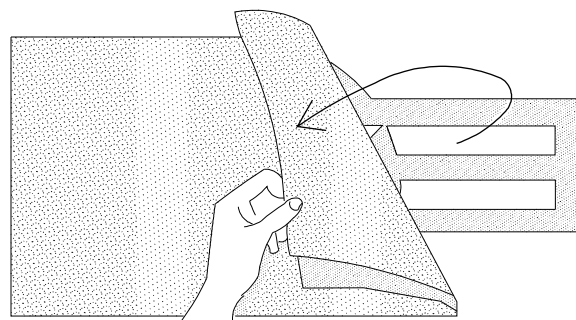


Figure 5-10. Use of Application Tape, Step 4

- b. Align emblem or letter with film side down and drop onto the adhesive. (See figure 5-8.)

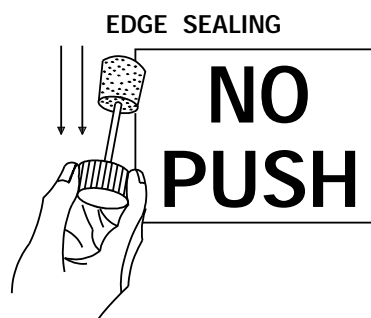


Figure 5-11. Edge Sealing

- c. Starting in the middle of the decal, squeegee to application tape with firm strokes of the plastic squeegee. (See figure 5-9.)
- d. Tape into position and follow application steps under hinge method.
- e. Remove tape by pulling directly back upon itself at 180°. Re-squeegee decal, especially the edges. (See figure 5-10.)

**5-16. EDGE SEALING.** Seal all edges of decals applied over the topcoat on the exterior of the aircraft. Decals that have been applied premasked over primer coat and subsequently top coated do not require edge sealing.

**NOTE**

When sealing of decal edges is required, 3M Edge Sealer, NSN 8030-00-195-7660, mfg part no. 4150, mfg code 34360, or NSN 8030-00-936-9940, mfg part no. 3950 will be used with polyester film decals (MIL-P-38477). Use of other edge sealers will cause early failure of 4000 series decal ink and polyester film decals (MIL-P-38477).

- a. Use the felt wick applicator attached to screw top can or use small narrow stripping brush.
- b. Apply sufficient sealer to effect a feather edging along the decal edge. (See figure 5-11).

5-17. **APPLICATION OF PREMASKED DECALS.** Decals that have application tape, (cut to the same shape as the decal) applied to the film side are supplied specifically for applying decals to the primer coat (MIL-P-23377 or equal only).

- a. Tape into position and follow application steps under "hinge method". (Paragraph 5-14.)
- b. After the topcoat of paint has dried, remove the masking in the same manner as shown in figure 5-10 except do not resqueegee.

5-18. **DECAL REMOVAL.**

<b>WARNING</b>
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- When using solvents and thinner Specifications MIL-T-19544, TT-T-266 and TT-N-95, observe this caution. Flammable vapor harmful. Keep away from heat and open flame. Keep container closed. Use only with adequate ventilation. Avoid prolonged or repeated contact with skin. Avoid swallowing.
- MIL-R-25134 is toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

5-19. For removal of decals conforming to MIL-P-38477, perforated, use paint remover. Specification MIL-R-25134. The film is a highly solvent resistant polyester, therefore, it is necessary for the paint remover to penetrate through the perforations to soften the adhesive. To accomplish this it may be necessary to use repeated application of remover. Remove film from adhesive. Another application of remover on adhesive may be required. Scrape off bulk of softened adhesive with a non-metallic scraper. Any adhesive residue may then be wiped

off with thinner conforming to Specification MIL-T-19544 or TT-T-266.

5-20. MIL-P-38477 type film without perforated holes, can only be removed by applying steam or dry heat to the decal and physically removing film. Any remaining adhesive can be wiped off with thinner conforming to Specification MIL-T-19544 or TT-T-266.

5-21. **APPLICATION OF MARKINGS WITH SILKSCREEN.**

5-22. This method can be used for painting internal and external markings and insignias as authorized by TO 1-1-4.

5-23. **Materials and Equipment for Silkscreening.**

a. **Equipment:**

(1) The use of locally fabricated or commercially procured silkscreens is authorized. Screen should be polyester mono-filament (220-280 megah).

(2) Squeegee, silkscreen, MIL-S-43252A.

b. **Materials:**

(1) Ink, Lacquer, A-A-663.

(2) Ink, Enamel, Alkyd, TT-E-489G.

(3) Thinner, Dope and Lacquer, A-A-857A.

(4) Aliphatic Naphtha.

(5) Topcoat, Lacquer, MIL-L-81352.

5-24. **SURFACE PREPARATION.** Prior to silkscreening, wipe area to be printed upon with Aliphatic Naphtha.

5-25. **APPLICATION.** Secure the silkscreen securely to the object being silkscreened.

**NOTE**

- The silkscreen ink being used may be either lacquer or enamel. Unless otherwise specified in the system peculiar technical order.
- If the part to be silkscreened requires a clear topcoat, insure all paints are compatible. (See paragraph 5-26.)

a. Place just enough ink on the top of the silkscreen, just above the design to completely cover the design when drawn. Using a square edge squeegee, draw the ink across the stenciled design using firm constant pressure. When complete, remove screen from equipment.

b. Clean screen, squeegee and other equipment using applicable thinner, and finish wash up with aliphatic naphtha.

<b>WARNING</b>
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MIL-C-83286 and MIL-L-81352 are flammable and toxic to eyes, skin, and respiratory tract. Eye and skin protection required. Good general ventilation is normally adequate.

#### 5-26. TOPCOAT APPLICATION.

##### NOTE

Silkscreened aluminum that has had a basecoat of polyurethane paint (MIL-C-83286) applied shall also have a topcoat of clear lacquer (MIL-L-81352) applied using an air spray gun, to improve the abrasion resistance of the silkscreen design. To avoid blurring of the silkscreen ink, apply a light coat of the clear lacquer initially. Follow with heavier coats and allow to cure dust-free.

#### 5-27. APPLICATION OF MARKINGS USING STENCILS.

5-28. This method can be used for painting internal and external markings and insignias as authorized by TO 1-1-4.

5-29. The use of locally fabricated or commercially procured stencils are authorized.

5-30. SURFACE PREPARATION. Prior to stenciling, wipe area to be stenciled with Aliphatic Naphtha.

5-31. Mounting Stencil. Stencil may be taped into position using MIL-T-21595, Type 2, Masking Tape or alternatively use 3M Repositionable Spray Adhesive 75, Manufacturer's Part No. 3M-75, Manufacturer's Code 34360. This Adhesive will securely hold the stencil but will not leave any residue when removed. The Adhesive is sprayed on the back of the stencil prior to mounting and will remain tacky enough to be reused several times.

5-32. PAINTING OF STENCIL. Stencil should be spray painted with a paint which is compatible with the topcoat to be stenciled.

5-33. Inverse Stencil Painting. Paint the area of the marking using an approved coating system in the color required for the marking. Allow the topcoat to become tack free. Remove the material that surrounds the stencil. Attach the stencil to the aircraft using transfer tape. Apply coating system. Remove stencil material after topcoat is tack free.



## SECTION VI

## APPLICATION AND REMOVAL OF THERMOPLASTIC POWDER COATINGS

## 6-1. INTRODUCTION.

6-2. Environmentally compliant, thermoplastic powder coatings (TPC), provide durable, extremely flexible, abrasion resistant coatings for certain applications. Equipment/parts that are subject to erosion/corrosion; and/or require acid/alkali resistance; that can withstand short exposures to the powder application temperatures of 450°F; and accept coating thickness >8 mils; are candidates for TPC usage, subject to the approval of the appropriate equipment item manager. Use of Air Force approved powder coatings eliminates volatile organic compound (VOC) and heavy metal releases associated with solvent borne coatings. TPC eliminates the need for primers, coating thinners, special coating facilities, flammable storage containment, and hazardous material storage and disposal of coatings normally associated with solvent coatings and chromate containing primes. Selection of the type and melt index of the TPC material and assessment of the application process is driven by the configuration and the operating environment of the equipment being coated. The powder coatings may be applied under a wide range of temperature and humidity conditions in covered or uncovered areas. The powder coating is designed to be applied over abrasive blasted metal.

## 6-3. SCOPE.

**WARNING**

TPC uses high temperatures and is not intended for use on aircraft or missiles.

6-4. TPC may be used on Air Force systems as an alternate coating in lieu of solvent borne conventional coatings only with the approval of the system/component item manager. This chapter covers the preparation, application, inspection, touchup and removal of thermally applied powder coatings on systems, structures, and pieces of equipment. Additionally, this section defines the coating systems, safety and environmental considerations surface preparation, coating methodology, quality production requirements, and follow-on inspection criteria.

**CAUTION**

Only trained personnel are authorized to use flame spray equipment.

## 6-5. TPC APPLICATION TRAINING.

- a. Several methods of training may be used for initial and follow on TPC applicator training.
  - (1) Equipment manufacturer's training.
  - (2) Air Force supplied local training.
- b. Equipment manufacturer's training may consist of on-site training or video training. Regardless of the method, it is essential the individual receives and understands the training given through a practical, locally developed certification method.
- c. An Air Education and Training Command (AETC) approved Plan of Instruction (POI) for flamespray TPC application is available through the Air Force Corrosion Program Office. Accomplish the training per the POI and annotate certification in the individuals training records.

## 6-6. METHODS OF TPC APPLICATION.

## 6-7. Flame Spray Application.

a. In this application process an open propane or natural gas fed flame is utilized to preheat the surfaces of the items being coated. The TPC is forced by compressed air through the propane or natural gas flame in order to melt the powder. The quasi-melted powder then impacts the heated surface of the area being coated. This process has several advantages in that the equipment is portable, and the environmental application range is wide. You may apply the coating in any indoor/outdoor area certified by the base fire department for open flame welding. During the preheating process, the flame drives off any moisture from the surface being coated, providing a dry surface ready to receive the TPC. For optimum coating service life, closely follow the specific manufacturers application instructions.

## 6-8. Electrostatic Spray Application with Infra Red (IR) Fusion.

a. Electrostatic spraying of powder is the most widely used method of applying powder coating materials. In the operation of an electrostatic powder spray system, powder is supplied to the

spray gun from a feeder unit, where the powder is stored for use. Powder is siphoned, or pumped, from a feeder unit through powder feed hose to the spray guns. An electrostatic charge is applied to the powder as it leaves the spray gun. The powder spray is directed toward the part to be coated in the form of a diffused cloud. The item being coated is electrically grounded and attracts the powder cloud. The powder adheres to the item being coated, with a transfer efficiency of approximately 95 percent. The item is then heated with IR heating elements or in a convection oven set at a predetermined temperature. The temperature setting and heating time is determined by the type of thermoplastic powder being used and the dimension/thickness of the substrate being coated. Components/equipment being coated may be preheated to 170°F, coated with TPC, and allowed to post cure until the coating is a consistent gloss. Monitor the coating's temperature to insure the coating is not overheated.

#### 6-9. Convection Oven Fusion.

a. The convection oven fusion process is ideal for coating complete equipment assemblies comprised of combinations of thick and thin metals and other parts not suitable for flame spray or fluidized bed operations. Electrostatic powder application equipment is used to apply the powder to the equipment/parts being coated. Do not overheat the parts being cured or excessive cross-linking of the powder coating will occur.

b. A forced convection curing oven comprises an insulated sheet metal enclosure through which the component passes, normally hung from an overhead conveyor or placed on jack stands on the floor. The components enter and leave the enclosure through an air curtain or natural heat seal. The ducting supplying the heated air is normally mounted along the top and sides of the enclosure. Within the insulated enclosure, hot air is circulated around the component to raise the component to the powder fusing temperature. The heated air is continually re-circulated and reheated. The actual configuration, shape and layout of the oven depends on the space available, size of equipment being coated and fusion times.

c. Follow the manufacturer's instructions for operating the convection oven and for maintaining heat range/fusion time for the selected powder. Components/equipment being coated may be preheated to 170°F, coated with TPC, and allowed to post cure until the coating is a consistent gloss. Monitor the coating's temperature to insure the coating is not overheated. Do not overheat the parts being cured or excessive crosslinking of the powder coating will occur.

#### CAUTION

When pressurizing the fluid bed, ensure the pressure regulator is set at zero "0". Excessive air may damage the membrane and/or blow the TPC out of the fluid bed.

#### 6-10. Fluid Bed Application.

a. In this process, a preheated part is immersed in a fluidized powder bed. The action of heat, and the powder coming in contact with the heated part, results in the melting of the powder and its adherence to the heated part. Material coating thickness on the part is determined by the temperature of the part, and the length of time the part is in the fluidized powder bed.

b. The fluidized bed is constructed as a two-chambered container or tank. The bottom chamber is a plenum connected to a source of regulated compressed air. The enclosed plenum is separated from the open top chamber by a porous membrane. The membrane supports the volume of powder coating material stored in the top chamber and serves to uniformly disperse the air rising up from the plenum. The rising air lifts and fluidizes the enclosed powder.

c. The size of the fluidized bed depends on the size of the part(s) to be coated. The fluidized may be locally manufactured. In designing the fluidized bed, the size of the tank, and the volume of material within the tank, must allow the part to be immersed below the upper level of the fluidized powder. Proper fluidization is governed by even distribution of air through the porous membrane, or plate, creating a lifting effect and agitation of the powder. The fluidized bed should be constructed with smooth walls which are virtually free of inside flanges, or other protrusions which come into contact with the powder material being used.

d. Most fluidized beds are round in shape to ensure proper air distribution within powder bed. The porous membrane, or plate, is constructed of any available porous material. Size and thickness of the membrane used should be sufficient to provide support for, and uniform fluidization of, the powder material. To prevent hot metal parts from touching/melting the porous membrane and extend the service life of the membrane, manufacture and install a cage of expanded metal to sit on top of the membrane with a minimum of one inch clearance.

e. Powder coating material is placed in the upper compartment at a predetermined level, usually approximately 30% full, to insure proper coating of the part when immersed into the fluidized powder bed. The porous membrane supports the powder supply within the lower compartment, or air plenum, for distribution through the porous membrane. Air passing through the porous membrane creates a lifting effect on the powder and gentle turbulence. The powder will lift approximately 40-50% by volume. This turbulence and the lifting effect creates a fluid like state of the powder and permits the introduction of parts to the porous powder bed for coating.

f. A preheat cycle is integral to coating in fluid bed. Different powders have different melting points. It is essential in fluid bed operations to deliver a hot part at the right temperature for optimum coating at the point of immersion in the bed. Typically, a 3-4 second immersion time of the heated component in the TPC will result in a 8-10 mil thick coating. Refer to the specific powder manufacturer for specific time and temperature of a powder.

g. Consistency in the time the part is dipped and the actual mechanics of the dipping operation are of utmost importance for good results. If the fluid bed is maintained in good condition, preheat temperature and time cycles carefully monitored and the dipping operation carried out with the same routine, a quality coating will be obtained.

#### 6-11. SAFETY AND ENVIRONMENTAL CONSIDERATIONS.

##### WARNING

Certain thermal powder spray systems use propane or other flammable gases. Follow all manufacturers safety guidelines.

a. Air Force approved powder coatings are inherently environmentally acceptable and non hazardous. To ensure this policy is maintained, use only equipment and materials listed on table 6-1, Consumable Powder Coating Listing, and Table 6-2, Equipment Listing. Only powder coatings approved by the Air Force Corrosion Program Office or Wright Laboratories may be applied on Air Force equipment. You should consult the Material Safety Data Sheets (MSDS) for hazards and precautions associated with a specific powder coating resins prior to commencement of thermal spray applications.

b. Observe all national, federal, state, provincial, and/or local regulations pertaining to "Safety In The Work Place" in the performance of all TPC application accomplished under the auspices of this document.

c. Follow all precautions contained in the specific manufacturer's printed instructions for their products used in this document. See the coatings container label and MSDS for specific precautions for the product used.

d. The applicator shall be familiar with, and observe, all owners safety regulations for the specific site at which TPC application is being done.

e. Do not use thermal spray equipment to coat items in areas containing, or immediately adjacent to, flammable, or explosive materials; this includes gas lines, solvent storage areas, etc.

f. Insure all gas connections and fittings are tight and that there are no fuel leaks; (i.e., use a liquid indicator solution or soap and water mixtures to look for gas leaks on all joints/fittings).

g. Do not have active ignition sources near fuel cylinders, hoses or gun nozzle.

h. Always wear eye protection and non-woven dust mask when handling powders.

i. Insure adequate ventilation. For interior coating, provide forced air ventilation and use air-movers to provide exhaust. Also provide cooling for applicator comfort such as dehumidified forced-air and/or fresh air conditioning hoods. In a closed vessel application consult your local bioenvironmental engineer for required air exchange requirements.

j. Insure the substrate is thoroughly prepared in accordance with this section.

k. Use area monitors to continuously monitor air for oxygen level and explosion limits, particularly during interior confined space coating operations. Applicators should also wear a personal monitor if possible.

l. Have serviceable fire extinguishers, remote communications, breathing air and eye wash bottles accessible to employees at the job site.

m. Insure the structure/substrate being coated is electrically grounded.

n. Follow all other applicable manufacturers' safety recommendations, procedures, and precautions

o. Observe all national, state/provincial, and local regulations pertaining to environmental protection and pollution abatement.

## 6-12. SELECTION OF THE APPROPRIATE POWDER COATING.

a. Powder coatings types currently authorized for Air Force use are polyethylene based, melt-blended ethylene-methacrylic acid (EMAA) copolymers, ethylene-acrylic acid (EAA), copolymers and ethylene-hydroxethylene (EVOH) copolymers.

b. "Melt-blending" refers to completely mixing UV stabilizers, pigments, and other additives with a melted base polymer before grinding. Dry blending is grinding the base polymer then combining the other constituents.

c. For Air Force use, the melt blend material provides more consistent color blend and shall be the standard for TPC applications.

d. Melt Indices (MI) refer to the industry standard in which plastic material is melted then extruded through a standard diameter hole. The amount of melted material that, at a specified temperature, is extruded through the hole in a specified time indicates the melt index. Typically, the higher the MI, the easier the melted material flows producing a smoother looking coating. Conversely, the lower the MI plastic coating are more viscous at a given temperature than are high melt index polymers. In general the low MI materials yield tougher coatings, have better adhesion and chemical resistance but are more difficult to apply and/or remove.

6-13. Plastic powder coatings can vary in performance from manufacturer to manufacturer. The powder coatings that meet Air Force requirements are melt blended and are listed on Table 6-1 by: Type, Melt Index (MI), Part Number, Manufacturer, and Source of Supply.

## 6-14. APPLICATION ASSESSMENT.

6-15. Successful application of thermally applied powder coatings requires a systematic approach to each project and compliance with several independent steps. The initial steps pertain to information gathering, and the final steps relate to coating inspection to verify proper application.

6-16. TPC applicators should conduct a preapplication assessment and survey is to determine the different variables such as: substrate type, recurring nondestructive testing requirements and methodology, physical obstructions, climatic exposures of the equipment, etc., and determine the most appropriate application material and procedure. The assessment normally is accomplished once for each type of unit being coated in order to familiarize the applicator with potential problem areas before TPC application commences.

6-17. Insure the availability of the powder coating material, thermal coating equipment and fuels, abrasive blast equipment/material, and safety equipment.

6-18. Review the job site preparations and set-up (equipment, fuel and material deliveries, open flame certification, if required.).

6-19. Inspect the application materials and equipment for proper type, cleanliness, contamination, proper operation, etc. (e.g., air compressor for moisture and oils, powder coating material for clumping, calibration of optical pyrometer and other gauges).

6-20. Inspect the surface preparation of the item being coated for cleanliness and surface profile.

6-21. Develop a preheating and coating sequence for the areas on an item to be coated first using the following steps:

### NOTE

Heat flow pre-testing of the substrate may vary depending on insulation, metal type, air flow, etc. One should determine the maximum direction of heat flow and utilize this heat for preheating of the substrate as the coating process continues. As an example of how to measure the direction of heat flow, the following guidelines are suggested:

a. Select a 2'x 2' area at least 2 feet from the bottom of the substrate.

b. Preheat the bottom half section (1'x 2').

c. Traversing horizontally, preheat to proper temperature, (consult manufacturers data sheet for proper temperature).

d. Map the average surface temperature using an optical pyrometer or contact thermometer. Measure the temperature at the top, middle, outside area, etc. and determine the heat spread and direction, heating uniformity, and whether the heat remains fairly localized.

e. Adjust heat hold time to 160°F± 10°F.

6-22. Continue monitoring the TPC application and substrate temperatures. Determine the fuel consumption, and coating deposition rates.

6-23. Observe the coating cool down and solidification for any imperfections, dry spots, bare areas, etc.

6-24. Determine the TPC thickness using a dry film thickness gauge and multiple measurement

averages. To ensure pinhole free coatings the average coating thickness should be >8 mils.

#### NOTE

Identify any pinholes and holidays by using low voltage wet sponge spark tester or visually inspect using a 3x magnifier.

6-25. Visually inspect the test item for good application techniques (cracks, blisters, cross-linking, discoloration, complete coverage, etc.).

#### 6-26. SURFACE PREPARATION.

6-27. Remove, disassemble or mask accessible hardware, trim, underwriter's labels, manufacturers' numbers, serial number labels, dials, gauges, signs and other items to allow proper application of the coating, and prevent damage or obliteration. For masking use heat resistant tape such as NELTAPE 8512-2 or 590-DL or equivalent.

6-28. Oil or grease shall be removed by the methods outlined by T.O. 35-1-12, prior to abrasive blast cleaning.

6-29. Abrasive blasting equipment shall be in good operating condition as required by the manufacturer. Oil and moisture separators shall be used. The oil and water separators shall be frequently drained and checked.

6-30. The metal surface shall be prepared in accordance with Steel Structure Painting Council (SSPC) SP 6-91, Commercial Blast Cleaning, as a minimum and SP 10-91, Near-White Metal Blast Cleaning, as the optimum surface preparation. Organizations may elect to use the abrasive blasting procedures listed in T.O. 1-1-8, Application and Removal of Organic Coatings in lieu of the SSPC guidance, however the final surface finish shall remain consistent with the following paragraph.

6-31. Minimum blast cleaning as defined by SSPC-SP 6-91, is complete removal of all oil, grease, dirt, rust, 1-mil scale and old paint. Generally, evenly dispersed very light shadow, streaks, and discoloration caused by stain of rust, stains of mill scale, and stain of previously applied paint may remain on no more than 33% of each square inch of surface area. Optimum blast cleaning as defined by SSPC-SP-10-91 is complete removal of all rust, scale, and other contaminants leaving a completely clean, near white colored surfaces. minor streaking/shadow of gray colored metal is allowable.

6-32. Visually inspect the surfaces to ensure minimum standards are met.

6-33. To reduce contamination of the coating media, abrasive blasting shall not be performed concurrently when coatings are being applied in the immediate location.

6-34. The compressed air used for nozzle blast cleaning shall be free of detrimental amounts of condensed water and oil. Nozzle pressure will vary depending on the substrate being blasted. Consult the blasting equipment manufacturers' users manual for selection of nozzle and blasting pressures based on the item being blasted.

6-35. Nozzle blasting shall use high quality glass beads, steel grit, or other abrasive materials to yield a 1.5 - 2.0 mil profile.

6-36. Abrasives used shall not contain materials which leave detrimental residues on the surface and shall be compatible with the substrate materials being blasted.

6-37. Remove all traces of grit, dust, and foreign matter after blast cleaning just prior to application of the powder coating using low pressure, oil-free, compressed air.

6-38. Blast-cleaned surfaces shall be coated before any scale rust begins to form.

6-39. Do not use marking materials that cause adhesion deficiencies, or as they may degrade the adhesion properties of the coating. Exception is on specific areas selected for recurring coating removal to facilitate bare metal nondestructive inspection.

6-40. To facilitate selected removal of TPC on specific areas apply a release agent, (NSN 9150-00-349-9290 or equivalent), on the specific inspection site(s) after each inspection and prior to coating or recoating. This will allow easy removal for NDI dye penetrate inspections.

6-41. Grit blasting should follow any water blasting or water cleaning to insure that the metal surface contains minimum oxides/hydrates (i.e., rust). The following is an example of typical surface preparation requirements:

#### CAUTION

Do not blast aluminum with steel grit or any of the same blasting media that had previously been used to blast ferrous metals, as extensive corrosion will occur.

6-42. TPC application on the substrate should occur as quickly as possible after surface preparation and/or abrasive blasting to minimize flash rusting/surface contamination.

**6-43. MIXING.**

6-44. Powder coating materials typically are ready-to-use out of the package. Sifting the powder through a flour sifter, cheese cloth or wire screen covered frame prior to filling the powder hopper is recommended to remove lumps.

6-45. Powder should be stored sealed in the original storage container to prevent moisture pickup which could interfere with free flow of the powder through the application system.

**6-46. APPLICATION EQUIPMENT.**

6-47. Air supply must be free of oil, moisture or other contaminants. Applicators should refer to the specific manufacturers users manual for system setup and operation.

6-48. The flammable gas supply normally requires a suitable gas regulator set between 10-15 psig.

6-49. Clean up consists of returning, unused powder to the storage container and blowing out equipment with air hose. Typically, as the powder does not contain hazardous materials, it is disposed of in a landfill. Consult local waste disposal offices for acceptable disposal practices.

6-50. All equipment shall be in good working order including air line filters, traps, gas regulators and gauges. All pertinent safety requirements shall be fulfilled.

**6-51. APPLICATION SEQUENCE.**

**NOTE**

Since optimum gun parameters are relative settings, there are no exact formulae or specific recommendations available for each particular situation. As such, the applicator must determine the optimum setting for each project.

6-52. Connect air and gas lines and set controls as described in the manufacturer's operations manual.

6-53. Optimize the flame and powder delivery per the equipment manufacturers users manual before actual application of the TPC.

6-54. Preheating.

a. To achieve adequate substrate wetting for good adhesion and to vaporize surface moisture, it is recommended that steel substrates be preheated between 175°F-200°F. The objective is to heat small "working sections" of the substrate surface or skin to required temperature and not to raise the temperature of the entire substrate all at

once. As the coating is applied, the adjacent areas will be preheated without additional attention. However, heavy flanges, weld seams, attachments or other heat sinks may require localized preheat. Use the infra-red pyrometer or contact thermometer for checking surface preheat.

**WARNING**

Should any metal surface buckling and/or warping appear, immediately cease all thermal spray applications and contact the Air Force Corrosion Program Office or the specific equipment item manager

b. The preheat temperature recommendation is dependent on polymer melt index, due to inherently different melt flow characteristics. The applicator should follow the powder manufacturer preheating requirements. Should the specific powder manufacturer recommendations not be available, typical preheat requirements are for: 3 Melt Index, 175°-200°F; 20 and 30 Melt Indices 150°-175°F. How well the substrate holds the heat and its specific heat spread will dictate how large a "working section" should be. However, the relative ease of obtaining and maintaining the required preheat temperatures may be affected by several variables such as: the substrate heat transfer/heat sink characteristics, ambient air temperatures, structure and substrate insulation, wind conditions, type of fuel source for TPC equipment, direction of heat flow substrate/structure system configurations (corners, weld lines, etc.). Typically, corners and confined areas tend to gain and retain heat; thinner substrates and sections typically gain and lose heat quickly; flanges and other thicker sections tend to require more heating but retains heat longer.

6-55. Preheating should proceed immediately in advance of powder delivery and in the direction of dominant heat flow. The TPC equipment itself, without powder delivery, is typically used to preheat the substrate. Where heating requirements are high, a second worker may use a gas torch immediately ahead of the applicator.

6-56. The coating process is done with the tip of the flame just touching the substrate. If the gun is held too close, the TPC may be overheated. The coating material wets the substrate, not merely impinges or sticks, and then readily flows to form a smooth coating due to latent heat from the substrate. No flame polishing should be required to achieve a smooth coating.

6-57. A grainy surface appearance is an indication the TPC is not being properly melted or fused. Corrective actions include increasing the length of the flame and/or decreasing the powder flow rate. Flame polishing (applying the flame only to the surface) should remedy any grainy surfaces.

6-58. Excessive gloss in the coating may be reduced by lightly rubbing the TPC coated surface with a very fine grade nylon abrasive mat, MIL-A-9962, until the desired sheen is achieved.

6-59. The TPC coating sequence shall be as follows:

- a. Apply the TPC from the bottom of the item being coated to the top with welds, flanges and thicker sections being coated first.

- b. Apply TPC to thin sections, corners and confined areas last.

6-60. Thermally sprayed powder coatings may be applied in multiple cross coats to achieve a uniform thickness and appearance. The base coat should be preheated to insure good fusion between the applied coats.

6-61. When coating on both sides of a thin substrate (i.e., 3/8" thick or less), coat the first side at a reduced temperature to allow for good impingement with partial "wet in" on the first side during normal coating of the second side.

- a. After coating the second side, check the first side to determine if "wet in" has occurred.

- b. If the "wet in" is incomplete on the first side, carefully flame polish by quickly heating the coating to proper temperatures. Do not linger at any one spot. (Note: two-sided coating and repair coating are the only two instances where flame polishing is recommended).

6-62. Minimum dry film thickness should be greater than 8.0 mils when inspected with conventional dry film thickness gauge. To provide corrosion protection powder coating should be pin hole free. To validate the integrity of the coating test the equipment being coated with a low voltage wet sponge holiday detector.

6-63. Practical coverage for 10.0 mils is 10 sq. ft. per pound. This may vary depending, on application environment and substrate.

6-64. No cure time of TPC is required. Coated equipment is ready for service as soon as it is cooled. Accelerated cooling of the equipment, with a water spray is permissible, if this is acceptable to the substrate.

6-65. COATING DIFFICULTIES AND REMEDIES.

6-66. Refer to Table 6-3, Trouble Shooting Guide, for equipment and material problems.

6-67. OVERSPRAYING EXISTING COATINGS.

6-68. TPC film repair consists of mechanically removing the damaged/crosslinked coating. Ensure heat of the surface being coated is adjusted to a minimum tack temperature of 200°-250°F.

- a. If the exposed area is less than 0.5 inch in diameter, flame polish the coating and allow the melt flow to cover the area.

- b. Larger touchup areas, greater than one inch, require the full application process only on the selected site. Ensure adjacent areas are not overheated.

6-69. REMOVAL CONSIDERATIONS. Thermal spray coatings resins are inherently difficult to remove by medium pressure abrasive grit blasting. However, grit blasting, scrapers and other manual tools may be used to remove coatings that have deteriorated or are substantially crosslinked. Intentionally inducing crosslinking, that is overheating of the powder coating during application or additional degradation by excessive heating after coating application will result in easier removal. For those areas requiring nondestructive inspections on bare metal brush a release agent (NSN 9150-00-349-9290 or equivalent), on the specific NDI site after each inspection and prior to coating or recoating. When removal is required carefully score the site and peel the coating off. Reapply the release agent after the inspection cleanup and before recoating.

6-70. For coatings that are still viable and have a low degree of crosslinking, or if induced crosslinking is not feasible, medium pressure hydro-blasting at 15,000 psi has proven to be a cost effective method for removal. Summarily, the more crosslinked a coating is, the lower the required pressure for removal. For example, 4,000 psi hydro-blasting has been used to efficiently remove a coating that was significantly crosslinked but still intact with about 900 psi adhesion. Use of medium pressure water blasting augmented with small amounts of sodium bicarbonate is an environmentally effective means of removing the powder coatings. Use only hydro blasting equipment authorized in the proper Table of Allowance. Additionally, conventional abrasive blasting at 600 psi removes the coating. Small areas may be reheated with a hot air gun or small propane torch to soften the thermoplastic and then manually scrape the area requiring removal while the coating is still soft.

6-71. QUALITY PRODUCTION STANDARDS.

6-72. All TPC application shall meet the minimum requirements of this document and reference standards.

6-73. No TPC application shall be started until all the proper permits have been obtained and all other safety and environmental requirements are met.

6-74. AFOSH and NIOSH requirements shall govern minimum standards where applicable and not specifically covered by this document.

6-75. A copy of this document and the specific thermal spray equipment operators manual should be maintained at job site while TPC application is underway.

6-76. All TPC application shall be done by qualified applicators who have received formal training from the equipment manufacturer or from Air Force trainers certified to have received formal training from the equipment manufacturer.

6-77. All coating material shall be delivered to job site in the original, closed containers. After use, unused powder shall be returned to resealable bags or containers.

**6-78. APPLICATION PROCESS INSPECTION.**

6-79. Applied coating should be of a uniform appearance without the grainy surface indicative of a cold, unfused application.

6-80. Coating should be free of pinholes as determined by a visual inspection or wet sponge holiday detector.

6-81. The applicator should have dry film thickness gauges for the type substrate being coated (ferrous/nonferrous), wet sponge holiday testers or 3x magnifying glass and any other equipment necessary to insure that this document is complied with. It is important to recognize that most, if not all, of the undesirable consequences of excessive thermal crosslinking are visible by careful, close inspection of an applied coating. However, there

are a number of less subjective, on-site and nondestructive methods to help assess whether a coating has been properly applied. The following is a list of practical characteristics that can be checked on-site after the coating has cooled and solidified:

a. Pinholes and Holidays: Pinhole/Holiday detection and elimination is critical for immersion/chemical contact services and less critical for outdoor/environmental exposures. Use a low voltage wet sponge spark tester such as M/1, KTA-TATOR Holiday Detector. An alternative method is to use a 3x magnifier to observe any substrate exposure.

b. Surface smoothness: Use shop-prepared thermally sprayed coupon standards to judge relative smoothness. The applicators should judge whether excessive surface roughness or an "orange peel" effect is indicative of either excessive cross-linking or under-heating. Improvement will require equipment adjustments and/or additional applicator practice improve the surface smoothness.

c. Surface gloss: For applications concerned about gloss factors use a hand-held, battery operated gloss meter, calibrated for a 60 degree gloss.

d. Coating thickness: Use a multi-point tester based on eddy currents; be sure to calibrate with standard films; particularly check edges, corners and welds for coating applied too thin or too thick. Excessive thickness is susceptible to excessive heat concentration for that given area.

e. Coating integrity: for blisters, bubbles, cracks, crazing, etc.

6-82. Residue from the approved thermoplastic powder application process may normally be disposed of as non-hazardous waste. Refer the Material Data Safety Sheets accompanying the powder to the base environmental management authority for any specific disposal requirements.



Table 6-1. Consumable Powder Coating Listing

**NOTE**

Indicate the color requested based on Fed Std 595, Color Guide.

TYPE	MELT INDICES	MANUFACTURER	SOURCE OF SUPPLY
EMAA	3	Morton Powder Coatings	Morton International 5 Commerce Drive Reading PA 19612-5240
EMAA	3	American Thermoplastics	American Thermoplastics Inc. 2266 South Dobson Road Mesa AZ 85202
EMAA	20	Morton Powders	Morton International 5 Commerce Drive Reading PA 19612-5240
EMAA	20	American Thermoplastics	American Thermoplastics Inc. 2266 South Dobson Road Mesa AZ 85202
EMAA	30	Plastic Flamecoat	ACR Process Equipment, Inc. Lake Mary FL 32795-0819  Plastic Flamecoat, Inc. 3400 West Seventh Big Springs TX 79720

Table 6-2. EQUIPMENT LISTING

ITEM	MODEL	MANUFACTURER
Flame Spray Outfit	ATI Falcon 2000 - 3" diameter flame spray outfit	American Thermoplastics Inc. Mesa AZ
Flame Spray Outfit	PFS 870000 - 1" diameter powder pistol with fluidized bed flame spray outfit	Plastic Flamecoat System, Inc. 3400 Seventh St. Big Springs TX
Dry Film Thickness Gage	POSITECTOR 6000 or equivalent	DeFelsko Inc. 802 Proctor Ave Ogdensburg, NY
Infrared Pyrometer	RAYNGER ST2 or equivalent	Raytech Inc.
Contact Thermometer	TAYLOR 9800 or equivalent	Taylor Mfg. Inc.

Table 6-2. EQUIPMENT LISTING - Continued

ITEM	MODEL	MANUFACTURER
Gardner Gloss Meter	GARDCO 4020 or equivalent	Paul N, Gardner Co., Inc. 218 Commercial Blvd Lauderdale-By-The-Sea FL 33708-4491
Wet Sponge Holiday Detector	KTA-TATOR M/1 or equivalent	KTA-TATOR Inc. 115 Technology Drive Pittsburgh PA 15275-1085

Table 6-3. Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	SOLUTION
Flame will not light	Propane bottle empty Propane bottle valve Propane hose connection	Refill Open Check all connections
No air supply	Compressor not running Air hose connections Air regulators on hopper	Start compressor. Check all connections Open regulator
No powder flow	Hopper empty Powder flow control valve Condensation/oil in the air supply	Fill hopper Open/Adjust powder flow valve Check oil and water separators/filters. Clean powder hopper. (Note: Change powder after cleaning hopper)
Plastic coating has a grainy appearance	Substrate not hot enough Plastic not melting Gun movement too fast	Preheat substrate to proper temperature Increase flame or decrease propelling air Slow down the movement of the gun to produce a "wetted" coating as it is being applied
Plastic burning or excessive smoking of the plastic as it is being applied	Flame too high Propelling air too low Application speed too slow Substrate too hot Flame too close to the surface	Reduce propane flow Increase propelling air flow Speed up application Remove heat source and let surface cool Increase distance of the gun from the face
Plastic coating peels off substrate	Surface not properly prepared Surface not adequately cleaned Substrate contaminated Plastic applied cold Contaminated blasting media	Abrasive blast surface to SSPC 6 or 10 condition After blasting surface must be cleaned to remove dust Wire brush surfaces then preheat surface to 200°F then abrasive blast Preheat surface, increase flame, decrease propelling air Remove contaminated media from blasting system., clean system, replace with new blasting media

## GLOSSARY OF ORGANIC FINISHING TERMS

**ACCELERATOR** - A substance which speeds up the polymerization of a synthetic resin.

**ACRYLIC RESIN** - Any of a group of transparent thermo-plastic resins formed by polymerizing esters of acrylic acid or methacrylic acid.

**ALIPHATIC** - An organic chemical whose carbon atoms are not in a ring form. A straight-chain compound. Mineral spirits, naphtha and kerosene are typical aliphatic compounds.

**ALKYD RESIN** - One of the major synthetics formed by polybasic acid reaction with polybasic alcohols. Primarily used for enamels but also in combinations in other types of coatings.

**ALLIGATORING** - A condition where cracks in the film are caused by contraction of the coating when a sudden change in temperature occurs during drying. It may also occur because of insufficient drying time between lacquer coats, or because of poor penetration or wetting or when a hard topcoat has been applied over a soft undercoat.

**AMINE** - An organic chemical containing carbon hydrogen and nitrogen. Certain amines may be used as convertors for epoxy resins.

**ANHYDROUS** - Containing no water.

**AROMATIC** - An organic chemical possessing the benzene ring structure. Benzene, toluol and xylol are typical aromatic hydrocarbons.

**BAKING FINISH** - Any paint or varnish which requires temperatures in excess of 150°F for the development of desired properties is a baking finish. The usual baking difficulties are the result of over-baking or under-baking schedules. Over-baking will result in a hard, brittle film with less adhesion than requirements demand. Proper correction of baking faults demands strict adherence to the instructions of the formulation of the finish.

**BINDER** - The non-volatile portion of a coating vehicle. It generally consists of drying oils, resins, or combinations thereof.

**BLEEDING** - The condition of bleeding is caused by pigments or dyes in the under surfaces floating up into the top coating. Bleeding may occur when material is applied with unclean spraying equipment.

**BLISTERING (OR BUBBLING)** - Blistering may occur when there is poor air circulation during drying of the coating. Unbalanced solvents in the structure of the lacquer will also cause this effect. Temperature differences between the part being sprayed and the coating will also cause air pockets or blisters. Daily draining of the water filters on air lines will help minimize this problem.

**BLOOMING (OR HAZING)** - The appearance of blooming is similar to blushing, though the underlying reasons are different. Blooming is the result of rubbing the finish too soon after application, the use of too coarse an abrasive or too hard a rubbing stroke. When blooming does occur, it may be removed by washing with a mild soap solution and warm water, followed by chamois skin. Properly dried and hardened surfaces will not bloom when rubbed or polished.

**BLUSHING** - Commonly referred to as clouding or whitening, blushing is the result of moisture being present on the film surface during the drying period. Although the fault commonly lies in improper drainage of the air line during finishing operations, the condition may also be caused by high humidity conditions within the finishing room. Improper selection of solvents will also cause blushing.

**BODY OF PAINT** - The body of a paint consists of the liquid portion with the exceptions of volatile solvents and water.

**BODYING** - See Gelling.

**BROWN SPOTS** - Brown spots will occur in a lacquer film when oil is permitted to get into the material. (As a precautionary measure, drain the water and oil separators daily.)

**BUBBLES** - When improper quality or quantity of reducer is used, bubbles often occur. To help prevent this defect, use correct proportions of thinner at all times.

**BUCKLING** - A nitrocellulose lacquer film may shrink or buckle when sprayed over an oil base undercoat. If necessary to overcoat oil paint with lacquer, make the first top coat as light as possible.

**CASE HARDENING** - The formation of a hardened top surface with a soft underbody. Proper relative humidity conditions within the drying room will assist in eliminating this condition.

**CATALYST** - A substance which changes the rate of a chemical reaction without itself undergoing permanent change in its composition.

**CHALKING** - Deterioration of an organic coating upon exposure that results in a powdery, chalky residue on a painted surface.

**CHECKING** - When slight breaks in the film which do not penetrate to the underlying surface occur, the condition is called checking. It occurs when lacquer coats are applied too heavily or without sufficient time allowed for drying between coats.

**COBWEBBING** - Filaments of paint which appear as cobwebs in lieu of fine droplets.

**COLLOID** - A very finely divided (but not molecular) dispersion of a solid in a liquid. Colloidal dispersions do not settle and the particles are too small to be observed by ordinary microscope.

**CONSISTENCY** - Consistency, in one sense of the word, is proportional to viscosity of the wet material. The term may also be applied to the resistance to deformation when referred to the cured film.

**CONVERTER** - A substance which causes a resin to polymerize or cure. Polyamides and amines are two examples of epoxy converters.

**COVERAGE** - The surface area which can be coated with a given volume of coating applied at a given film thickness. Coverage is usually expressed in square feet per gallon at one mil dry film thickness. Coverage is not related to hiding power.

**COVERING POWER OR HIDING POWER** - When applied to an organic coating, covering power indicates either the degree to which the base material has been obliterated from view or the relative smoothness or surface leveling a material may produce.

**CRACKING** - Cracking occurs when the various components of a lacquer are not blended or mixed properly, or when coatings not compatible with one another are used together.

**CRATERING** - A defect in a coating resulting in craters or fish eyes. Most often caused by the presence of grease, oil, silicone polishes or other similar contaminants on the surface.

**CRAWLING** - Crawling is the reverse of crazing, that is, a more flexible coating is applied over a hard or brittle film.

**CRAZING** - When lacquer films expand and contract, a series of fine hair line cracks (crazing) results. Crazing frequently occurs when a very heavily pigmented surface coat is applied over a more flexible undercoating. The elastic coating of lower filler content will expand and contract more easily than the heavily pigmented coating.

**CRYSTAL LACQUERS** - A decorative finish which is achieved by recrystallization of dissolved lacquer bases. It occurs after the thinners have evaporated. Pearl essence or mother of pearl finishes may be produced in this fashion.

**CRYSTALLINE FINISH** - A crystalline like, decorative finish is accomplished by using certain gas checking oils which on drying produce the pattern.

**CURDLING** - Curdling usually occurs when a high evaporative weak solvent thinner is employed in a lacquer enamel. Control of solvency and evaporation rate will prevent curdling.

**DECALCOMANIA** - The process of transferring to glass, wood, etc, decorative pictures or designs printed on specially prepared paper.

**DILUENT** - A diluter; a material blended with an active solvent in an organic coating to increase its volume and/or reduce its viscosity.

**DISPERSION** - An intimate mixture of finely divided solid particles in a liquid substance. Paints are dispersions of pigments in a vehicle.

**DOUBLE COAT** - A double application of paint. This does not mean two consecutive passes of the spray gun. One coat is applied by a double or cross pass of the gun followed by a second similar application after the first coat has set up.

**DRIER** - A catalytic material which when added to a drying oil or drying oil modified coating accelerates the rate of drying. A substance which speeds the reaction of binder with oxygen. Naphthenates of lead, cobalt, and manganese are common driers.

**DRYING OIL** - Drying oils are those which readily absorb oxygen from the air to form durable films.

**DRYING TIME** - The time required for a coating to attain various stages of dryness. Three commonly referred to drying times are: dry to touch, dry to handle and dry hard (recoat). Drying time is greatly affected by temperature, humidity and air movement.

**EMULSION** - An intimate suspension of two or more liquid substances which are not mutually soluble but which do not ordinarily separate. Examples: milk (butterfat and water), self-polishing floor waxes (wax, solvent, water), vehicle for water-thinned latex paints.

**ENAMEL** - An enamel is a coating characterized by an ability to form an especially smooth finish film.

**EPOXY RESIN** - A synthetic resin produced by the reaction of epichlorohydrin and bisphenol. Epoxy resins may be used alone (unmodified) or modified with drying oils (epoxy esters) for coating vehicles. Example: Specification MIL-P-23377, epoxy primer.

**EXTENDER PIGMENTS** - Pigments used to provide texture, bulk or hardness to a coating. Also known as inert pigments. Magnesium silicate and diatomaceous silica are examples of extender pigments.

**FILLER** - A filler is a material of pigmented composition used to fill irregularities and undesirable depression after a primer coating and prior to a finish coating.

**FILLING POWER** - The degree a filler material hides irregularities of texture.

**FLASH POINT** - The minimum temperature at which the vapors of a liquid will ignite or burn. An indication of the flammability of a product; the higher the flash point, the safer the product. Measured on the Tag Closed Cup.

**FLATTENING AGENT** - A flattening agent is one which when added to coating materials reduces the gloss of the cured film.

**FLOODING** - A change in color progressing from the time a coating is applied until the time it sets. Caused by fines in the pigment portion floating to the surface. The result is a final shade different from the original.

**FORCE DRYING TEMPERATURE** - Temperatures usually considered as force drying are those between room temperature and 175°Fahrenheit.

**GELLING** - When a liquid phase is transformed to an irreversible solid phase without the loss of weight through evaporation, the phenomenon is often termed gelling.

**GLOSS, SPECULAR** - The luster, shininess, or reflecting ability of a surface or the ability of a surface to reflect light regularly. It is based upon the degree of optical smoothness of a surface, variations in smoothness being microscopic. Values above 70 are classified as being full gloss, 70 to 30 as semi-gloss, 30 to 6 as eggshell, 6 to 2 as flat to eggshell and 2 or less as flat. Six or less is also classified as lusterless.

**HARD SANDING** - When the ratio of binder to pigment is improper, lacquer films may remain soft or wet so that they stick to sandpaper during sanding. To overcome this difficulty, stir the material thoroughly before using, apply lighter coats, and allow longer drying time intervals between coats.

**HOLIDAY** - A term used to indicate a skipped area, missed unintentionally while applying a coating. Holidays can be avoided by using contrasting colors for alternating coats.

**HYGROSCOPIC** - Possessing the ability to attract or absorb water.

**INFRARED LAMP** - A heat lamp commonly used in paint drying operations.

**INHIBITOR** - A substance which slows down a chemical reaction.

**INORGANIC** - Chemical compounds based chiefly on elements other than the carbon-hydrogen-oxygen group. Inorganic compounds are divided into four classifications:

Acids - Such as sulfuric, hydrochloric (muriatic), nitric, phosphoric.

Alkalies - Such as sodium hydroxide (caustic soda), potassium hydroxide (caustic potash), ammonium hydroxide (ammonia).

Salts - Produced by the reaction of an acid and an alkali such as sodium chloride (table salt), magnesium sulfate (epsom salt), calcium chloride, copper sulfate.

Oxides - A combination of a metal and oxygen such as iron oxide (rust), zinc oxide (white rust), titanium dioxide (white pigment), silicone dioxide (sand and glass).

**LATEX** - Water suspension of fine particles of rubber or rubber-like materials.

**LEVELING** - The degree to which a film will smooth out after application is its leveling ability. Improper solvent or driers may prevent proper leveling.

**LEAFING** - The ability of an aluminum or gold bronze paint to exhibit a brilliant or silvery appearance. This occurs when the flap pigment particles align themselves parallel with the coated surface so as to give the appearance of a solid sheet of metal.

**LIFTING** - Lifting of a film usually results when a lacquer coating is applied over another coating which has not dried sufficiently to permit proper adhesion. In all instances where one finish is applied over another it is important that the undercoat be sufficiently dry; otherwise, poor adhesion will result. Good keying of the finish will minimize lifting.

**LIVERING** - When the pH of a paint is lowered, such as when acid-producing reactions occur in the material, the paint will gell or liver. In many cases this difficulty can be remedied by slowly stirring into the livered material a very slow paint reducer.

**MIL** - A unit for measuring the thickness of a coating film. One mil equals 1/1000 (0.001) inch.

**NAPHTHA** - The product of the distillation of the solvent fractions obtained from the thermal decomposition (cracking) of coal or petroleum. A volatile, flammable fluid consisting chiefly of mixed hydrocarbons.

**NITROCELLULOSE** - In coatings, basically used as a binder for most lacquers; principally air drying. It may be modified with resins and plasticizers for improved gloss, adhesion and flexibility. An ester of nitric acid and cellulose produced by the action of nitric acid upon wood, cotton, or some other form of cellulose in the presence of concentrated sulfuric acid.

**NON-FERROUS** - Pertaining to metals other than iron.

**NON-VOLATILE VEHICLE** - The liquid portion of paint, enamel, varnish, or related products excepting the volatile thinners and water.

**ORANGE PEEL** - Pebble effect appearance caused by too high air pressure during spraying, or occurring when the spray gun is held too close to the surface, or when a quick-drying thinner is used which prevents the normal flow of lacquer solids.

**ORGANIC** - Chemical compounds chiefly composed of hydrogen and oxygen in a multitude of molecular arrangements. The term organic was established when it was thought that organic compounds could be produced only by living organisms. Many organic compounds are produced synthetically today. However, even these are derived from former living plants and animals (coal and oil are the chief sources of raw materials for organic chemicals). Examples of organic compounds: gasoline, alcohol, sugar, fish oil, glycerin.

**ORGANSOL** - Finely divided or colloided dispersion of a resin in a plasticizer with solvents or other materials.

**OXIDATION** - A chemical reaction involving the reaction of a substance with oxygen. Iron rusts by oxidation. Oil-containing coatings dry or cure by oxidation.

**PERMEABILITY** - The extent to which a coating or other film will allow air or water to pass through it.

**pH** - A term used to indicate acidity or alkalinity. The pH scale runs from 0 to 14; pH 7 is neutral, less than 7 is acid, 7 to 14 is alkaline. The further the rating is from seven, the greater the acidity or alkalinity.

**PIGMENT** - The solid particles used in the preparation of paints, lacquers and enamels which are substantially insoluble in the vehicle and provide color, film protection and special effects.

**PITTING** - This is a condition which will occur when a lacquer is sprayed at high pressures and at temperatures below 65°F. It will occur if lacquer used in spraying has been stored in a cool place and has not been allowed to attain room temperature.

**PLASTICIZER** - Substances added to soften or otherwise modify the properties of a finished resin without excessive sacrifice of strength and rigidity.

**PLASTISOL** - Colloided dispersion of a resin in a plasticizer in a resin without solvent.

**POCK MARKS** - Pock marks are often trapped air bubbles in a porous surface. Too high air pressure or too thick a coating can result in pock marks. To overcome this condition, apply thinner coating, use less air and use a thinner of high solvency.

**POLYMER** - A substance composed of giant molecules formed by the combination of a number of simple molecules with one another.

**PRIMER** - That coating applied directly to the basic metal and upon which a subsequent coating is to be applied is termed the primer.

**PSI** - Pounds per square inch. A measure of pressure of fluids and gasses.

**RAISING** - The appearance of wrinkles or blisters in a film; often due to a reaction of lacquer solvents with unoxidized oil films in oil base undercoats.

**RELATIVE HUMIDITY** - The amount of moisture in the air as compared with the amount it could contain at the same temperature, expressed as a percentage.

**RESIN** - A natural or synthetic substance usually organic in composition, characterized by being amorphous (noncrystalline), isotropic (properties being the same in all directions), plastic, often sticky and usually fusible and soluble at some stage in its manufacture or processing.

**RUNS** - A condition resulting from too large an amount of organic coating material or thinner applied to an area.

**SOLVENT** - Any liquid which will dissolve another substance. Solvent power of a liquid is specific, that is, it can dissolve certain substances but not others.

**SPRAY DUST** - Spray dust results when a spray gun is held too far from the work, especially when a highly volatile thinner is used. This is caused by solid particles in the coating material being dried up while traveling from the nozzle to the surface being sprayed. Insufficient thinning or too high air pressure may also cause spray dust. Corrected by spraying at lower air pressures at distances between 6 to 8 inches from the work or by increasing the thinner content.

**STRIPPING** - Removing old paint from a surface.

**SURFACE TENSION** - The property of a liquid by which the surface film of a liquid tends to form into a sphere. Surface tension affects the ability of a liquid to wet a surface.

**THIXOTROPY** - The property of a coating which causes it to undergo a gel-sol-gel transformation upon agitation and subsequent rest. Upon agitation it becomes quite fluid but readily falls back again to the semi-solid form after the agitation is stopped.

**TONER** - Toners are organic pigments which do not contain inorganic pigment or inorganic carrier bases.

**VARNISH** - A varnish is a liquid resin material which after application converts to a transparent or translucent solid material.

**VEHICLE** - A vehicle is the liquid carrier portion of a paint.

**WET SPOTS** - When metals are not cleaned of oils and greases before painting, those areas which retained the foreign material become wet spots. The condition is characterized by a sticky coating film which requires extremely long drying time and often remains soft or wrinkled. Stripping of the paint film and refinishing may be required.

**WRINKLE FINISH** - In those cases where wrinkling is undesirable, it is a defect caused by

improper application, usually of a too heavy coating or by abnormally high or too rapid a rise in temperature or high humidity. Avoid these conditions by applying thinner films and allowing sufficient drying time between coatings. Extremes of temperatures and humidity should also be avoided.

**No. 2 ZAHN Cup** - A small portable viscosity measuring device.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
4	ABRASIVE POLISH	Cerium oxide	CLEANING OF NESA WINDSHIELD PANELS	Mix abrasive polish, optical quality, with water to a thin paste consistency. Spread mixture on affected surface of the windshield. Polish the glass with a wide rotary motion using cloth, CCC-F-466, or oscillating type buffer such as MIL-S-9838, Type C3A2. The pressure on the buffer must be light. Prevent drying of the polishing compound by addition of water or mixture on the glass. Rinse the windshield with clear tap water and immediately dry with clean, damp chamois.	This action is to be used only to remove surface film and stubborn foreign deposits. No attempt shall be made to remove nicks or scratches using this procedure. It is important that the glass not be allowed to heat up during the cleaning operation.
5	O-T-620 1,1,1 TRICHLOROETHANE (METHYL CHLOROFORM)	1,1,1 Trichloroethane Inhibitors	CLEANING OF RADOMES AND REMOVAL OF FUNGUS.	Plastic electrical insulation is cleaned by wiping with a lint-free cloth or sponge moistened with O-T-620. Areas adjacent to electrical components and motor casing, etc., may be cleaned with O-T-620 using wipe-on, wipe-off procedure. Radomes may be cleaned by wiping with a lint-free cloth moistened with O-T-620.	O-T-620 shall be used with adequate ventilation or respirator. Avoid prolonged or repeated breathing of vapor or contact with skin. Do not use on or allow entry of vapor in oxygen systems thru breathing devices, open line, etc.



Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
6	P-D-680, Type II DRY CLEANING SOLVENT (FLASH POINT 138°F)	Petroleum distillate	REMOVAL OF GREASE, OIL, AND LIGHT SOILS IN AIRCRAFT AND MISSILE CLEANING	To remove oily residue, grease and hydraulic fluid, apply P-D-680 with a wiping cloth or sponge and remove with a clean wiping cloth. After cleaning a surface/part with P-D-680, Type II, follow with MIL-C-25769 solution to remove solvent residue.	Do not mix P-D-680 with MIL-C-25769 for cleaning. P-D-680, Type II, does leave a slight residue on a surface as it evaporates which may interfere with the adhesion of paint films and must never be used for final wipe down just prior to painting. Type I material is not approved for cleaning.
7	TT-1-735, GRADE A ISOPROPYL ALCOHOL	Isopropyl Alcohol	REMOVAL OF FUNGUS FROM PLASTICS	Plastics are cleaned by wiping with a lint-free cloth or sponge moistened with clean water or a solution of isopropyl alcohol, distilled water mixed 50-50 and 2 ounces per gallon detergent MIL-D-26937.	Mixture (50-50) of alcohol and water is flammable (flash Point 60°F). Use with adequate ventilation.
8	MIL-C-25769 AIRCRAFT SURFACE CLEANING COMPOUND, ALKALINE WATERBASE 90% BIODEGRADABLE	5% by weight ethylene glycol, n-mono butyl ether, remainder optional	CLEANING OF PAINTED OR UNPAINTED SURFACES (IMMERSION, SPRAY OR VAPOR CLEANING NOT PRACTICAL) AND CLEANING OF SURFACES AND COMPONENTS EXPOSED TO GUN AND ROCK-ET BLAST.	Clean painted or unpainted surfaces with one part MIL-C-25769 diluted with ten parts water for lightly soiled areas. For moderate to heavily soiled areas, dilute one part MIL-C-25769 with five to eight parts water. Apply solution by spraying or with a mop, sponge, or brush.	Do not allow MIL-C-25769 to dry before rinsing. No serious problems are created in disposal of this cleaning compound.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
				Agitate the compound by scrubbing with a non-metallic brush, MIL-B-23958 or with the new type aircraft surface mop. Thoroughly rinse MIL-C-25769 solution from the area/part being cleaned by using large amounts of clean potable water. Dry the cleaned surfaces by wiping with clean, dry rags. For cleaning exhaust track and rocket blast areas, dilute one part MIL-C-25769 with three parts water.	
9	MIL-D-26937 SYNTHETIC DETERGENT	Alkyl benzene sulfonate	REMOVAL OF TRAFFIC FILM AND OTHER OPERATIONAL SOILS FROM PLASTIC SURFACES AND FUNGUS REMOVAL FROM METAL SURFACES.	Use in concentrations of 1 to 2 ounces per gallon of water. Apply to plastic by means of soft cloths or photographic cellulose sponges. Go over the surface with the bare hand to detect any abrasive material that could scratch the plastic surface. Dry with a clean damp soft cloth with care not to continue rubbing the transparent plastic after it is dry. Clean with an approved cleaner such as P-P-560. Clean fungus from metals by scrubbing.	Do not use coarse, hard dirty, or gritty cloths in cleaning and polishing transparent plastics. Remove rings or any hard objects from hand before washing the transparent plastics. Do not use unapproved cleaning fluids, compounds, solvents, etc.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
10	MIL-C-27251 CLEANING COM- POUND, AIR- CRAFT SURFACE	Petroleum solvent Diethylamine Triethanolamine Oleic acid Sodium heptadecyl sulfate Ethylene glycol Fatty alkylol amide condensate Tertiary-alkyl primary amine	REPEATED COLD WEATHER AIRCRAFT CLEANING WHEN CLOSED FACILITIES ARE NOT AVAILABLE (+32°F to 0°F)	Spray the surface until a thin, continuous film has been deposited. Brush treated surface with a round soft bristle brush conforming to Specification MIL-B-23958. After the compound has been on the surface for a minimum of 10 minutes, spray a thin coating of solvent, Federal Specification P-D-680, Type II, or anti-icing fluid, Specification MIL-A-8243 over the treated surface and repeat the brushing. Rinse the compound from the surface by means of a high pressure spray of anti-icing fluid, Specification MIL-A-8243 or solvent, Federal Specification P-D-680, Type II.	When working with Specification MIL-C-27251 material, precautions shall be taken for personnel protection. Wear eye, face, body and hand protection equipment. Protect lubricated parts and natural entrappings from the cleaning and rinsing fluid by masking. Inspect lubricated areas after cleaning and re-lubricate if necessary. MIL-A-8243 is mildly toxic and contact with skin or eyes should be avoided. Contact of this fluid with oxygen may result in fire or explosion. Excessive use or long dwell time of P-D-680 may cause damage to painted surfaces, plastics, rubber items, etc.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
11	MIL-T-27602 TRICHLOROETHYLENE	Trichloroethylene	CLEANING OF SURFACES WHICH HAVE BEEN TREATED WITH CORROSION PREVENTIVE COMPOUNDS, AND REMOVAL OF LOOSE CORROSION PARTICLES IN OXYGEN STORAGE AND TRANSFER SYSTEMS.	Surfaces which have been protected with corrosion preventive compounds shall be cleaned with MIL-T-27602 using clean cloths or sponges. Follow with MIL-C-25769 and water if required. In areas of oxygen storage and transfer systems, remove loose corrosion particles with MIL-T-27602. Apply only to immediate corroded area.	Do not allow solvents to splash or run because they also remove paint and damage elastomers (rubber, plastic, etc). Trichloroethylene produces dangerous and toxic fumes. Avoid breathing fumes over a prolonged period of time or in confined areas. Provide adequate ventilation and wear approved protective clothing.
12	MIL-C-83360 ELECTRICAL CONTACT CLEANING AND LUBRICATING COMPOUND	Trichlorotrifluoroethane, Type II Silicon fluid Propellant	REMOVAL OF DUST, DIRT, OIL, GREASE, OXIDE FILM, ETC, FROM ELECTRICAL CONTACTS, ROTARY SWITCHES, ETC, WHEN RESIDUAL LUBRICATION IS REQUIRED.	Hold can upright about 4 to 6 inches from surface to be cleaned and direct a light spray onto the contacts. When the cleaner is applied to a rotary switch, rotate the switch several times to clean it, then apply a thin coating for lubrication if required by specific equipment directives.	This material shall not be used where the residual lubricant may interfere with the proper operation of the equipment.

**NOTE**

Some cleaning solvents, such as trichloroethane, may be regulated by local government. Contact the Base Bioenvironmental Engineer for restrictions on use or substitute material.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
DEGREASING & HEAVY DUTY CLEANING					
13	P-C-437 STEAM CLEANING COMPOUND	Optional	CLEANING OF VARIOUS FERROUS AND NON-FERROUS SURFACES IN STEAM AND HOT WATER CLEANING MACHINES	When used in steam cleaners, the compound will be thoroughly dissolved to give a concentration of approximately 10 ounces of the compound per gallon of water. A nozzle concentration of 0.3 percent (0.4 ounce per gallon) is suitable for average cleaning. Add new solution as necessary to maintain proper concentration. In hydro-steam units, P-C-437 will be used at a concentration of 2 pounds per 50 gallons of water. If hard water is prevalent, 0.2 percent by weight of detergent, Specification MIL-D-26937, may be added to increase the efficiency of this solution. MIL-D-26937 may be used alone at a ratio of 2.5 ounces per gallon or 2.0 percent by weight with satisfactory results.	Mix P-C-437 in concentrate tank of the cleaning machine, or in a separate drum. The dry compound must be added to the hot water in preparing the solution and not vice versa. Exercise extreme care when using steam or hot water. Always direct the nozzle at an angle of 45 degrees to the surface being cleaned. Do not use P-C-437 on aircraft only on components.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
14	MIL-C-5543 WASHING MACHINE COM- POUND FOR METAL PARTS	Silicates Phosphates Carbonates Detergent (low sudsing)	REMOVAL OF COR- ROSION PREVEN- TIVE COMPOUNDS, OILS, AND GREASE FROM STEEL, BRASS AND ALUMINUM PARTS	Use 1 ounce MIL-C-5543 per gallon of water in industrial spray washing machines.	Steam cleaning compound P-C-437 may be substituted if MIL-C-5543 is not available. A small quantity of kerosene, VV-K-211, may be added to these solutions when an excessive buildup of foam occurs during operation.
15	MIL-C-18718 SOLVENT CLEANING COM- POUND	Standard solvent Dichloromethane Tetrachloroethylene	REMOVAL OF GREASE, FUNGUS, AND GROUNDING DIRT FROM PHOTO- GRAPHIC PROCESS- ING EQUIPMENT, ELECTRICAL AND ELECTRONIC MATERIAL; ENGINE COMPONENTS, SMALL ARMS, ARMAMENT, ETC, WHERE A LESS TOXIC CLEANER THAN CARBON TETRACHLORIDE IS REQUIRED	Before applying coating material, swab on MIL-C-18718 safety solvent, dispersed from plunger-type safety can, using clean cloths. The area will be wiped with a tack-rag immediately before painting. Engine cleaning at temperatures below 20°F requires solvent MIL-C-18718. Allow solvent to remain on surface for a period of 5 to 10 minutes, then rinse with additional solvent.	Tack-ragging will be accomplished on each area to be finished immediately prior to application of finishing material to the area. In no case will tack-ragging of an entire large area prior to finishing the area be sufficient. Normal cleaning of an engine should not require more than approximately 10 gallons of solvent for cleaning and 5 gallons for rinsing.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
					Extreme care must be exercised to remove excess solvent from engines. This can best be accomplished by forced evaporation with use of compressed air (10 to 15 psi). This cleaning compound is combustible and will not be used in confined areas, where there are open flames, arcing equipment, hot surfaces, or where smoking is permitted. Use only with adequate ventilation. Avoid prolonged or repeated breathing of vapor. Do not get in eyes, on skin, or on clothing. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. For eyes get medical attention.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
CARBON REMOVAL					
16	MIL-C-19853 CARBON REMOVER COMPOUND	Optional	REMOVING OR LOOSENING CARBON FROM AIRCRAFT ENGINE COMPONENTS BY IMMERSION AT AMBIENT TEMPERATURES WITHOUT AGITATION	To prevent contamination of carbon remover solution, remove all loose oil, grease, and dirt from the parts by degreasing. Place parts in a mesh basket, or suspend by wire, and immerse in the lower layer of the solution. Allow the parts to soak approximately two hours, depending on the hardness and extent of the deposits to be removed. Raise the parts slowly, permitting the parts to come in contact with the upper layer for approximately 30 seconds, then remove from the tank. Rinse parts with hot water under pressure and allow to dry.	This material contains a volatile solvent, methylene chloride MIL-C-19583. Carbon removing compound is a cresylic acid containing material and must be confined to tank use with very careful and thorough disposal practices. This material will be used only in a tank provided with a cover and in a well ventilated area.



Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
PAINT REMOVAL					
17	NON-CRESYLIC NON-PHENOLIC REMOVER  PAINT REMOVER	Chlorinated Hydrocarbons Methanol	REMOVAL OF MULTIPLE COATS OF EPOXY AND POLYURETHANE PAINT	Apply by brush or nonatomizing sprayer to produce a smooth, even coat over the area to be stripped. Apply full strength and allow sufficient dwell time for thorough penetration and loosening of the paint. When paint is loosened thoroughly agitate all areas with a stiff bristle brush. If paint is still adhering in some areas, reapply and allow additional time before rinsing. Rinse the paint residues with high pressure, high volume cold water, or with a steam cleaning machine. Brushing during the rinse operations insures complete removal of all paint residues.	This material is poisonous. It may be fatal or cause blindness if swallowed. Avoid ingestion or prolonged inhalation. Use only in well ventilated area and avoid contact with skin, eyes and clothing. Vapors are hazardous to breathe and/or will cause skin burns. Any paint remover on the skin or in the eyes must be flushed immediately with large amounts of water. Medical treatment should be sought promptly in the case of its entering the eyes or if material is swallowed. Protective clothing and equipment such as rubber gloves, aprons, boots, air supply or filter respirators, appropriate eye shields and goggles will be used as necessary to provide adequate protection for personnel.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
					Refer to product label for additional precautionary information. This material has a shelf life of 6 months. It should be stored in a protected area out of direct sun. Keep from freezing. Preferred storage temperatures are 40° to 100°F. It will attack plastics; therefore, plexiglas windows should be protected. Also, protect rubber window seals and tires.
18	PHENOLIC TYPE REMOVERS  PAINT REMOVER	Phenol Methylene Chloride	REMOVAL OF EPOXY AND POLYURETHANE COATINGS FROM EXTERIOR ALUMINUM AND MAGNESIUM SURFACES OF AIRCRAFT AND MISSILES		Vapors are hazardous to breathe and/or will cause skin burns. Any paint remover on the skin or in the eyes must be flushed immediately with large amounts of water. Medical treatment should be sought promptly in the case of its entering the eyes. Under certain conditions, the material may become ignitable. Protective clothing and equipment such as rubber gloves, aprons, boots, air supply or filter respirators,

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
					appropriate eye shields and goggles shall be used as necessary to provide adequate protection for personnel. These materials have a shelf-life of 6 months.
19	TT-T-266 DOPE AND LACQUER THINNER	Ketones Alcohols Hydrocarbons	SAME AS TT-E-751	Same as TT-E-751	Same as TT-E-751
20	TT-E-751 ETHYL ACETATE, TECHNICAL	Ethyl acetate	PAINT REMOVAL WHERE USE OF EMULSIFIABLE STRIPPER IS IMPRACTICAL BECAUSE OF COMPLEXITIES OF ASSEMBLY AND RINSING DIFFICULTIES	Apply solvent with soft bristle brush or clean cloth. Allow the solvent to remain on surface until all paint has softened and lifted. To keep the area wet with solvent, it may be necessary to cover the surface with a cloth saturated with the solvent. Wipe all solvent/residue off with a clean damp cloth, frequently rinsing the cloth in clean water. Repeat procedure if necessary until all paint and residue has been removed. Wipe clean and dry with a clean, lint-free cloth.	In areas of oxygen storage and transfer systems, use extreme caution when using TT-T-751, or TT-T-266, or other solvents that are not oxygen compatible. Do not use the solvent on flanges, valves, or other components where there is a possibility of the solvent coming in direct contact with oxygen. Do not splash or spill solvents on adjacent elastomers (rubber, synthetic rubber, plastics, etc.) since deterioration will result.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
21	MIL-D-6998, GRADE B  DICHLOROMETHANE, TECHNICAL	Dichloromethane	PAINT STRIPPING IN AREAS WHERE THERE IS A POSSIBILITY OF SOLVENT COMING IN CONTACT WITH OXYGEN	Same as TT-E-751	Dichloromethane is toxic. Provide adequate ventilation and avoid breathing the fumes. Avoid contact with the skin. Do not allow solvent to spread to adjacent areas not being treated. Do not splash or spill solvents on adjacent elastomers (rubber, synthetic rubber, plastic, etc) since deterioration will result.
22	MIL-R-25134  PAINT AND LACQUER REMOVER	Organic solvents Evaporation retarders Wetting agents	PAINT REMOVAL FROM AIRCRAFT AND OTHER METAL SURFACES	Apply MIL-R-25134 with a long handled nonmetallic brush or low pressure nonatomizing spray, using barrel pump FSN 4940-735-3202. When paint has softened or lifted (preferably lifted), agitate the surface and then rinse with water. Repeat procedure for stubborn spots.	MIL-R-25134 has a shelf life of 6 months under normal conditions. Close surveillance will be made of the age of the material when it is to be used on metallic surfaces. Any material which is questionable will be laboratory tested for conformance to specifications, with particular attention to corrosion potential, prior to use. Prevent contact of paint stripper with acrylic rubber, lubricated parts, windows, canopies, and radomes. Keep out of louvers and scoops not requiring stripping. The barrel, pump, hose, nozzle, etc, must be thoroughly rinsed with water immediately after use.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
CORROSION REMOVAL					
23	PASA-JELL 102 CORROSION REMOVER, ALUMINUM TYPE	Mineral acids Activators Inhibitors Inorganically thickened	CORROSION REMOVAL FROM ALUMINUM IN AREAS WHERE LOX COMPATIBILITY IS A REQUIREMENT	Agitate areas of deep pitting with a short-fibered acid-resistant brush or abrasive mat, MIL-A-9962, Type I, until corrosion products are removed. A thin, smooth and evenly dispersed film will give the best result. Dwell time should be held to the minimum (5-12 min) necessary to effectively remove the corrosion. Dwell time can usually be controlled by closely observing the reaction of the acid mixture with the aluminum surface to which applied. After the corrosion removing material has been allowed to dwell for the required time, rinse away with a stream of water or wipe off with a clean, moist cloth, frequently rinsing the cloth in clean water. One application of Pasa-Jell should be sufficient in most cases; however, in severe cases, the preceding steps may have to be repeated. Attention	Do not use aluminum or steel wool to apply or agitate Pasa-Jell. Fire will result. Pasa-Jell is a relatively strong acid mixture and can be detrimental to equipment/components if improperly used; therefore, it will only be used where LOX compatibility is an essential requirement and by personnel who are properly trained/qualified to use the material for corrosion removal. Excessive use of abrasive and acid corrosion remover causes unnecessary removal of protective clad or metal.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
				should be given to pitted areas until all corrosion is removed. Questionable areas should be examined with a four power or stronger magnifying glass. Corrosion still on the area will appear as a powdery crust and slightly different in color than the uncorroded base metal.	
24	O-C-303, TYPE 2 CHROMIUM TRI-OXIDE	Chromium trioxide	REMOVAL OF SURFACE OXIDATION AND LIGHT CORROSION PRODUCTS FROM MAGNESIUM SURFACES	Prepare a solution by mixing 24 oz of O-C-303 to enough water to make one gallon in a container of lead lined steel, stainless steel, or 1100 aluminum. Mask off nearby operating mechanisms, cracks, and plated steel to keep the solution from attacking them. Warm the solution to 190 to 202°F. Apply the chromic acid solution carefully to the corroded area with an acid resistant brush. Allow the solution to remain on the surface approximately 15 minutes.	This method will not be used for parts containing copper-based inserts unless the inserts are masked off. Excessive amounts of anions, such as chlorides, sulfates, and fluorides must not be allowed to build up in the solution as these anions tend to coat or etch the metal rather than clean the surface. Always add the chromium trioxide to the water, do not add water to the chromium trioxide.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
				(Solution can be operated at room temperature for a longer reaction time). Agitation may be required. Thoroughly rinse the solution from the surface with plenty of clean water. Repeat the preceding sequence as necessary until all corrosion products have been removed and the metal is a bright metallic color. Apply the chemical pretreatment ment and final protective finish recommended for the area. This procedure is not considered adequate where deep pitting or heavy corrosion has occurred because mechanical methods are required, nor is it satisfactory for removing sand or the effects of blasting.	

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
25	MIL-C-5541, TYPE 1A  CHROMATE CONVERSION COATING	Chromates Hydrofluoric Acid	METAL PRETREATMENT FOR CORROSION PREVENTION AND REMOVAL OF SURFACE CORROSION	Dissolve the MIL-C-5541, Class 2 powder in clean tap water in a ratio of three ounces of powder per gallon of water. Use only a container made of plastic, rubber, or stainless steel to mix, dispense, or store the solution. Activate the solution by adding concentrated nitric acid (approximately 70 percent HNO <sub>3</sub> ). Add 5 ml of nitric acid to each gallon of solution and check the time required to obtain the iridescent yellow to brown on a sample of the alloy to be coated. Add acid in 5 ml increments until a coating time of less than 5 minutes is reached. Do not exceed 15 ml of acid per gallon. Apply the activated MIL-C 5541 to affected area by spray, cloth, or sponge. Immediately scrub the surface with an abrasive mat like MIL-A-9962. Shortly after scrubbing, the coating should develop a light golden iridescence. If a greenish or black color appears in the solution, soils or oxides are present. Rinse with water and repeat procedure until surface is uniformly colored gold.	Do not use activated MIL-C-5541 solution on anodized surfaces unless the anodic film needs to be removed. Do not use on magnesium, titanium or high strength steel alloys. This solution is highly acidic due to excess nitric acid and should be handled with caution to avoid body contact. Wear rubber gloves and a protective face shield to prevent burns in the event of splash. Add the acid to the solution.



Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
26	MIL-M-10578, TYPE 3 METAL CONDITIONER AND RUST REMOVER	Phosphoric acid Remainder optional	REMOVAL OF CORROSION FROM FERROUS METAL SURFACES AND CONDITIONING THE METAL SURFACE PRIOR TO PAINTING	Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals. Remove any grease or soil. Remove heavy rust by chipping and/or brushing. Add one part of the concentrated material as received to one part of water by volume. Add the acid to the water. Use acid resistant mixing tanks. Apply the material to the corroded area with brush to swab. Allow material to remain long enough to loosen the rust (2 to 10 minutes depending on the degree of rusting). Remove the material by rinsing, preferably with hot water. The material must be completely rinsed from the part. If corrosion is still evident, repeat. Dry the part and immediately apply the protective paint or other corrosion preventive finish.	Type III material should always be rinsed off with water after application. Do not use acid material if there is danger of trapping the material in crevices, recesses, or on high strength steels. Steel parts heat-treated above Rockwell C40 (180,000 psi) tensile strength are subject to hydrogen embrittlement and the use of acids is prohibited. The material contains a strong acid. Protect hand, face, and eyes. Wear protective clothing. Avoid prolonged breathing of vapors.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
				For removing heavy rust from small parts, an immersion treatment may be used. Corrosion resistant steel tanks are preferred for the immersion treatment. Remove grease and loose corrosion. Mix one part rust remover to one part water by volume. Immerse the parts in the solution only long enough to loosen the rust. For removal of heavy rust, the solution can be heated to 140°F maximum. Agitate the work in the solution, to further increase the rate of rust removal. Rinse in a continuously overflowing cold water rinse tank, if available, or spray with clean, preferably hot, water. Dry the parts and immediately apply the final protective paint or other corrosion preventive finish.	

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
27	MIL-C-14460, TYPE 1  ALKALI TYPE CORROSION REMOVING COMPOUND	Sodium hydroxide Trisodium salt of N-hydroxy ethylethylene diaminetriacetic EDTA tetrasodium salt dihydrate Sodium gluconate Phosphorous Silica Others, including foamers	RUST REMOVAL BY SIMPLE IMMERSION OF THE PARTS AND CLEANING OF COPPER AND BRASS AND TO STRIP PHOSPHATE COATINGS	Prepare alkaline rust remover, Specification MIL-C-14460, Type I, in accordance with manufacturers instructions as printed on the container. The usual concentration employed for Type I material is 5 pounds per gallon of water. Carbon steel or corrosion resistant steel tanks may be used. Immerse parts in the rust remover solution. Rust removal time varies with the extent of the rust. Temperatures up to boiling point may be used to increase the rate of rust removal. Rinse thoroughly in clean, preferably hot, water. Dry thoroughly and immediately apply final protective finish or other corrosion preventive compound. Rust can be removed from critical or machined surfaces with the compound without causing dimensional change of the part.	Rust remover, Specification MIL-C-11460, Type I, is highly alkaline, therefore - harmful to skin and eyes. Operators should wear rubber gloves, aprons, and goggles when working with the material. Use with adequate ventilation. Do not use alkaline rust to remove corrosion from aluminum alloys. Do not process dissimilar metals in the solution.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
28	MIL-C-19647 CORROSION REMOVING PASTE COMPOUND, PHOSPHORIC ACID BASE	Phosphoric acid base	REMOVAL OF LIGHT AND MODERATELY HEAVY RUST FROM FERROUS SURFACES	If present, remove grease and oil from surface before using MIL-C-19647. The paste should be applied about 1/8 inch thick with a brush and allowed to remain on the surface until all the rust is removed. If all the rust is not removed after 30 minutes, a second application should be made after a water flush. The treated area should then be wiped dry or thoroughly flushed with fresh water if practical and wiped down.	Subsequent surface finishing should be accomplished as soon as possible after repairing the surface since rusting will occur.

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
29	MIL-C-38334 CORROSION REMOVING COMPOUND	Phosphoric acid base	REMOVAL OF CORROSION FROM ALUMINUM AIRCRAFT SURFACES AS A PREPAINT TREATMENT	Pitted surfaces and/or surfaces (aluminum) with a powdery metallic residue which was not removed by cleaning should be treated with MIL-C-38334. If aircraft is being prepared for complete painting or repainting, all cleaned bare aluminum surfaces should be prepared for treatment. Prepare MIL-C-38334 solution by diluting with an equal volume of the water before using. Mix the compound only in wood, plastic, or plastic lined containers. Apply the solution by spray, mop, sponge, or brush. If the surface is being prepared for painting, do not apply sooner than 24 hours prior to the application of the paint system/surface finish. When applying the solution on large areas, begin application on lower surface and work upward, applying in a circular motion, brushing enough to loosen the surface film. Allow the	When using Specification MIL-C-38334 solution, take particular care to keep acid out of faying surfaces, butt joints, seams, crevices, etc. The wipe-off technique is recommended for ducting, tubing, stringers, and similar parts, followed by a thorough rinsing of the treated area with clean water. When working with any acid solution for corrosion removal, keep the acid confined to the area being treated. The acid will be kept away from operating mechanisms, magnesium alloys, steel parts, especially steel screws and fasteners in stressed panels (wings, etc). All parts and assemblies, especially cadmium plated items and hinges susceptible to damage by the acid compound, will be masked and/or protected. Mask all

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
				<p>solution to remain on the surface for approximately 12 minutes and then rinse away with plenty of (tap) clean water. Heavily pitted or corroded areas may require more than one application and/or warm application (140°F maximum). Hand agitating may also be necessary. After each application, examine the pits and/or corroded area with a 4-10 power magnifying glass to determine if another application is required. Corrosion still on the area will appear as a powdery crust slightly different in color from the uncorroded base metal. Darkening of the area due to shadows and reaction from the acid remover should not be considered. The specification MIL-C-38334 material is basically intended for use as a pretreatment prior to application of a protective coating; however, it also can be used to remove corrosion products from aluminum alloy material or items (skins, stringers, ribs in wings, tubing, ducts, etc).</p>	<p>openings leading to the primary structure and any other openings which might allow the acid (uncontrolled) to get into the aircraft or equipment interior. Specific examples of extremely critical areas on most aircraft are the landing gears, engines, main framing and support members of the landing gears, engines, elevons, elevators, rudder, wings and wing stubs (longerons, spars, webs, beam caps, supports, mounting brackets and braces). Wear acid resistant gloves, protective mask, and protective clothing when working with acid compounds. If acid accidentally contacts the skin or eyes, flush off immediately with clean water. Report to the dispensary if eyes are affected or if skin is burned. Not to be used where LOX compatibility is a requirement. Corrosion removing compound, prepaint, Specification MIL-C-38334, is for use only on aluminum</p>

Table 1. Cleaning Materials For Air Force Weapon Systems (Cont)

ITEM NO.	SPECIFICATION NO.	MATERIAL INGREDIENTS	SPECIFIC OPERATION	APPLICABLE PROCEDURES	REMARKS & CAUTION NOTES
					alloys and shall not be used on or rinsed over magnesium. It will be used on aircraft only when required to remove corrosion as a prepaint treatment and will not be used solely for the purpose of enhancing the appearance of equipment or aircraft. Use of the compound under the premise of corrosion removal is also prohibited. When the compound is accidentally splashed or spilled, remove immediately by rinsing with water or wiping with a wet rag. It is good practice to keep a wet rag on hand at all times for removal of spills or splashes.

NOTE: ALL AIR FORCE CLEANING COMPOUNDS AND PROCEDURES ARE NOT INCLUDED IN THIS CHART. USE OF OTHER COMPOUNDS AND PROCEDURES IS ALLOWED PROVIDED THEIR USE IS IN ACCORDANCE WITH APPROPRIATE TECHNICAL ORDERS. FOR COMPLETE INSTRUCTIONS AND PRECAUTIONS ON CLEANING MATERIALS APPEARING ON THIS CHART, CONSULT APPROPRIATE TECHNICAL ORDERS.

## LIST OF RELATED SPECIFICATIONS

Number	Title
MIL-E-74	Enamel, Lusterless, Quick Drying
MIL-B-121	Barrier Material, Grease Proof, Water Proof, Flexible
MIL-B-131	Barrier Material, Water Vapor Proof, Flexible
MIL-R-3043	Resin Coating, Permanent, "For Internal Engine Parts"
MIL-M-3171	Magnesium Alloy, Processes for Corrosion Protection
MIL-C-4556	Coating Kit, Epoxy
MIL-A-4864	Aluminum Wool
MIL-W-5044	Walkway Compound, Nonslip
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-C-5543	Cleaning Compound, Washing Machine, Aircraft Metal Parts
MIL-E-5558	Enamel, Wrinkle-Finish, for Aircraft Use
MIL-A-6091	Alcohol, Ethyl, Specially Denatured
MIL-T-6095	Thinner, Cellulose-Nitrate - Dope Blush Retarding
MIL-C-6799	Coating, Sprayable, Strippable, Protective
MIL-F-7179	Finishes and Coatings, General Specifications for Protecting Aircraft
MIL-P-7962	Primer Coating, Cellulose Nitrate
MIL-C-8514	Coating Compound, Metal Pretreatment, Resin-Acid
MIL-A-9962	Abrasive Mats, Non-Woven, Non-Metallic
MIL-E-12507	Enamel, Phenolic, Lusterless, Outside
MIL-P-15929	Primer Coating, Shipboard, Vinyl-Red Lead
MIL-P-15930	Primer, Paint, Vinyl, Zinc Chromate Type
MIL-E-15932	Enamel, Outside (Gloss Black)
MIL-E-15933	Enamel, Outside, Dull Black, (Vinyl-Alkyd)(Formula No. 122-3)
MIL-E-15935	Enamel, Outside, Gray, (Vinyl-Alkyd)(Formula No. 122-11)
MIL-P-15936	Paint, Outside, Gray No. 27, Vinyl Alkyd
MIL-C-16555	Coating Compound, Strippable, Sprayable
MIL-F-18264	Finishes, Organic, Weapons System, Application and Control of
MIL-L-19537	Lacquer, Acrylic Nitrocellulose
MIL-L-19538	Lacquer, Acrylic Nitrocellulose, Camouflage
MIL-T-19544	Thinner, Acrylic - Nitrocellulose Lacquer
MIL-T-19588	Toluene-Methyl Isobutyl Ketone Mixture
MIL-S-22805	Spray Kit, Self Pressurized
MIL-P-23377	Primer Coating, Epoxy Polyamide
MIL-T-23397	Tape, Pressure Sensitive, Adhesive
MIL-E-24307	Enamel, Exterior, Gray (Vinyl-Alkyd)(Formula No. 122-R08)
MIL-R-25134	Remover, Paint and Lacquer
MIL-C-25769	Cleaning Compound, Aircraft Surface, Alkaline Water-Base
MIL-P-26915	Primer Coating, Zinc Dust Pigment for Steel Surfaces
MIL-C-27227	Coating, Polyurethane, For Aircraft Application
MIL-C-27725	Coating, Polyurethane, Integral Tank Interiors
MIL-C-83445	Coating System, Elastomeric
MIL-C-38334	Corrosion Removing Compound, Pre-Paint Treatment
MIL-P-38336	Primer Coating, Inorganic Zinc
MIL-C-38427	Coating Kit, Top Coat, Pigmented for Zinc Rich Surfaces
MIL-P-38477	Plastic Material, Pressure Sensitive
MIL-C-81706	Chemical Conversion Material for Aluminum and Aluminum Alloy
MIL-T-81772	Thinner, Aliphatic Polyurethane Coating
MIL-C-83231	Coating, Polyurethane, Rain Erosion Resistant
MIL-C-83286	Coating, Urethane, Aliphatic Isocyanate
MIL-R-83936	Remover, Paint, Tank Type
O-A-51H	Technical Acetone
O-C-303	Chromium Trioxide, Technical
P-C-436	Cleaning Compound, Alkali, Boiling Vat (Soak) on Hydrosteam
P-D-680	Solvent, Dry Cleaning



## LIST OF RELATED SPECIFICATIONS

Number	Title
TT-L-20	Lacquer, Camouflage
TT-P-28	Paint, Aluminum, Heat Resistant
TT-L-32	Lacquer, Cellulose Nitrate, Gloss
TT-L-58	Lacquer, Spraying, Clean and Pigmented Cellulose Nitrate
TT-P-86	Paint, Red Lead, Ready Mixed
TT-N-95	Naphtha, Aliphatic
TT-V-119	Varnish, Spar, Phenolic Resin
TT-M-261	Methyl-Ethyl-Ketone, "For Use in Organic Coating "
TT-T-266	Thinner, Dope and Lacquer, "Cellulose-Nitrate "
TT-M-268	Methyl-Isobutyl-Ketone, "For Use in Organic Coating "
TT-T-291	Thinner, Paint, Volatile Mineral Spirits, Petroleum Spirits
TT-T-306	Thinner-Synthetic Resin, Enamel
TT-P-320	Aluminum, Powder and Paste
TT-P-460	Pigment, Zinc-Dust, Dry
TT-E-489	Enamel, Alkyd (Gloss)
TT-E-496	Enamel, Heat Resisting Black
TT-E-527	Enamel, Alkyd (Lusterless)
TT-E-529	Enamel, Alkyd, Semi-Gloss
TT-T-548	Toluol, "For Use in Organic Coating"
TT-E-751	Ethyl, Acetate, Technical, Organic Coating
TT-E-776	Ethylene Glycol Monobutyl Ethyl, "For Use in Organic Coatings"
TT-E-781	Ethylene Glycol Monobutyl Ethyl, Technical
TT-T-801	Turpentine, Gum Spirits
TT-B-846	Butyl, Alcohol, Normal, "For Use in Organic Coating"
TT-X-916	Xylene, "For Use in Organic Coating"
TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity

## LIST OF RELATED TECHNICAL ORDERS

TO NUMBER	TITLE
00-20K-1	Inspection and Age Control
1-1-691	Cleaning of Aerospace Equipment
1-1-691	Corrosion Prevention and Control for Aerospace Equipment
1-1-4	Exterior Finishes, Insignia, and Markings Applicable to USAF Aircraft
1-1-24	Maintenance, Repair and Electrical Requirements Fiber Laminated and Sandwich Contracted Radomes
31-1-221	Field Instructions for Painting and Preserving Electronics Command Equipment
42A-1-1	Safety Fire Precaution and Health Promotion Aspects of Painting, Doping and Paint Removal
42A1-1-3	Solvents Approved for Air Force Use in Maintenance Operations
42A2-1-4	Storage Control of Paint Material
42A2-1-10	Hot Spray Application of Lacquer and Dope
42C2-1-7	Process Instructions - Metal Treatments, Electrodeposition of Metals and Metal Surface Treatments to Meet Air Force Maintenance Requirements